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# China Report

## SCIENCE AND TECHNOLOGY

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29 APRIL 1987

CHINA REPORT  
SCIENCE AND TECHNOLOGY

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## NATIONAL DEVELOPMENTS

### BETTER TREATMENT OF SCIENTISTS, EDUCATORS URGED

Beijing XIANDAIHUA [MODERNIZATION] in Chinese No 10, Oct 86 pp 12-13

[Article by Yang Xiandong [2799 7359 2639]: "Let Workers in Science Education Make More of Their Aspirations"]

[Text] Over the past few years, I have represented the China Science and Technology Association going to more than 10 provinces, cities, and autonomous regions in the southwest, the central southern area, the northeast, and the northwest to visit more than 50 counties and many townships, and I have joined with more than 1,000 scientists and technicians in conferences or individual conversations. Last year I also went to the United States and to Great Britain for more than 4 months to visit colleges and science research organizations in more than 20 cities, and met and talked with more than 300 specialists, scholars, and overseas students who have either foreign citizenship, Chinese ancestry, or who have left Taiwan Province. In accordance with my understanding of things, I will now speak to some extent of my experiences, and will propose some suggestions in accordance with them.

#### I. Go Further in Implementing Policies Toward Intellectuals, and Fully Arouse the Enthusiasm of Workers in Science and Education

Since the 3d Plenum of the 11th CPC Central Committee, there have been many achievements in implementing policies toward intellectuals, and funding for science research has been increased; there have also been improvements in the conditions for scientific research teaching, where the problems of posts, wages, and housing for science education personnel have had appropriate resolution and adjustments. To have achieved so many results within this short a time is truly heart warming. In the previous 2 years, the China Science and Technology Association, together with 1,800 advanced S&T workers from border regions and from national minority regions who had been commended by pertinent ministerial commissions, all of them working under extremely arduous conditions, made praiseworthy achievements. To a certain degree, this also reflected the success of the party's policies toward intellectuals.

However, as an S&T worker of the older generation I cannot help but say that we have not done enough, and that we are not yet in step with the development of current trends.

Abroad, I also listened to conversations with scholars of Chinese ancestry who were concerned about the construction of China. They believe that although scientists and technicians in the motherland have assumed certain duties, they have yet to fully realize their potential. Some have even made this analysis: the average scientist or technician has only realized 50 percent of his or her potential, and a greater portion have realized only 30 percent of that potential, while there have not been many scientists who can use 70 percent of their potential. Regarding this viewpoint, I sought out the opinions of some domestic scholars under many different situations, some of whom said that this estimate was more or less accurate, while some said that the estimate was still too high. One older agriculturist in Nanjing told me emphatically that because of mismatched personnel and no assistants, he not only had to do the scientific research, but also observe the instruments, wash the jars, manage the experimental plots, and go shopping for things. I asked, are there no agricultural workers? He said, yes, there are agricultural workers wearing high heels. Because of this, where he is capable of producing three or four achievements, in fact he only produces one.

Intellectuals in this country, we Chinese, are truly talented and capable. Among those overseas students who have left the country over the past few years, many have been outstanding scientists, and many have been subjected to all sorts of schemes by foreigners trying to get them to stay there. This year, at a commemorative celebration for the 100th anniversary of the completion of the Statue of Liberty in the United States, 12 outstanding American citizens were presented with Freedom Medals by the president, among whom one-fourth were Chinese scientists of American citizenship. In scientific fields in Europe, in Japan, in Southeast Asia, and in other countries and regions of the world, the praise and accomplishments obtained in recent years by Chinese have been enough to make us proud.

Last year in the United States, many scientists of Chinese ancestry said to me: "Everyone only knows of Dr Yang Zhenting, the Nobel Prize winning physicist, but in Chinese academic circles, there are people with the talent of Yang Zhenting in all the disciplines of physics, engineering, agriculture, and medicine; it is just that conditions are not right in which to allow them to better pursue their aspirations."

I have said all these things in order to explain that there are "great people" in Chinese S&T circles, with great potential for development. With further implementation of policies toward intellectuals, science research achievements can quickly be doubled, quadrupled, or even more.

## II. Enhance the Restructuring of the Science Teaching System, Where Scientists and Technicians Will Have Duties and Authority

Currently, scientists have taken a hand in general science research units and higher level institutions. But there are still not a lot of true duties and authority, things in which they can have the final say, and this is especially true for the authority to employ people and to retire them. I once met with a deputy academy director from an agricultural academy who said: "For some of the resolutions at academy business meetings, I am afraid that those in which the deputy secretary participated are repudiated when they reach the

secretary." We can see that respecting talent and knowledge is still some distance from the objective facts. This distance has been created due to historical reasons that have not been eliminated even yet. For example, there are some science researchers whose work is not suitable to them, whose conditions regarding equipment is deficient, whose specialties are not necessarily geared to their jobs, but it has been a long time since this was conveyed to higher authorities and there is still no resolution. Therefore, their potential, intelligence, and skills have all been discounted, where in name they are engaged in a specialty, but in reality their talents have been buried. In the northwest, I met with a female scientist, who had in the past been selected by the party for study abroad in the GDR. She told me quite bitterly: "In response to a summons by the higher authorities, I came here to help 8 years ago, but the laboratories, instruments, and library equipment I need have still not arrived. I am already 47 years old, and should retire in another 8 years." There was also a female scientist in Nanjing who worked in medical engineering. In recent years she had studied in France, obtaining a PhD, and has also made inventions, had important reports in French newspapers, and she was invited to stay in France by her fellow workers, which she refused. After returning to this country, because she had neither funding nor equipment, she had no way to continue her research, with the result that all she could do was change professions, which has hurt her deeply. Naturally, examples of this sort are relatively scarce, but all are very real problems.

How ought we to solve these real problems? I believe that we must believe in S&T workers, must earnestly respect knowledge, respect talent, and treat them as belonging among us. First of all, we should give them duties and authority within a certain professional scope. We all know that in the past farmers had no autonomy when tilling the earth, and agricultural production ground to a halt. With the implementation of the production responsibility systems, where the farmers had autonomy, production then went on. Under a similar principle, scientists and technicians should also have autonomy before they can promote S&T development, but what is this autonomy? This is personnel authority, financial authority, and material authority for science research and for education. In a few words, science education personnel should truly be their own masters in their research and education units, and it is especially true that they should not only have the authority to advance people, but also to dismiss them, as well as the authority to promote them in posts and in rank, and to promote new people.

### III. Streamline Science Research and Education Organizations, and Improve Work Efficiency

Based on comparisons I have made over the past few years visiting within this country and abroad, I feel that many science research and teaching units within this country are overstaffed, too large, and that there are too many people in administrative operations and odd-job personnel, even to the extent that the academic atmosphere is thin and that there are problems with organizational working styles. Even less can they understand that "time is money, and efficiency is life." When I had arrived at an institute of agricultural science, I found there were more than 200 staff in all, only 6 of whom were technical personnel, and when I asked the institute director what was going on, he said, "All are relatives with connections, so I have no

choice but to employ them." I went to another agricultural institution, where the number of people who could not teach nor do science research were a great proportion of the total. There was in fact little difference between the number of staff and the number of students.

I sought out the opinions of many comrades regarding these phenomena, and they unanimously agreed that we must do a great deal of streamlining, for otherwise our limited funds will all be eaten by "head-count funding," and even more important, when there are more people than work, there is no way that work efficiency can improve. I asked about just how much could be streamlined. Some said it could be as much as one-half, and some even said two-thirds. Obviously, our "common ricebowl" and "iron ricebowl" problems have gotten very serious indeed! This, too, is a vestige of feudal times, and is something that has arisen from the so-called "connections faction."

For science research and education units, where to begin with funding was insufficient and conditions were deficient, to then add to that so many redundant personnel, that is sure to eat away all the money that should be spent on science research and teaching. We therefore will certainly be bold and resolute in our execution of the reforms, and will retrain those who are eliminated due to streamlining before transferring them to places they are needed. They will go to pertinent service professions and to the border regions. If we are to achieve this, we must thoroughly eliminate the "connections faction," and persist in carrying out "incorruptable and impartial."

After undergoing an earnest streamlining, a hiring system can be employed for scientists, educators, and administrative personnel, including reserve personnel, belonging to science and educational organizations, and an election system can be employed for leaders. Only in this way can the lifelong system be gotten rid of and can employment be in terms of worth and can people make the most of their talents.

#### IV. Improve S&T Workers, Especially the Spiritual and Material Lives of Scientists and Technicians at the Frontiers

The high-level intellectuals I met with in this country were invariably older. But in other countries, some specialists and professors appeared to be simply youngsters, just 30-some years old, while the major portion of 30-odd year old science and education workers in this country are more likely assistant teachers, assistant engineers, assistant agronomists, and technicians. There are not many 30-year-old lecturers, engineers, or agronomists. This cannot but affect their enthusiasm. On this problem of job upgrades and promotions, we should cry out loudly in order to attract sufficient attention. Naturally, this problem touches on many aspects, primary among which are the conditions for creativity, and helping and promoting improvements in the levels of scientists and technicians. This is also one aspect of improving their spiritual lives.

When I went to several frontier areas, I found that conditions there, whether it be equipment, funding, education, or life, are all quite lagging behind those of interior areas. If we are to allow them to produce more

achievements, then we must create the necessary conditions for them. This century is already the century of the computer, and the next century will be the century of biological engineering, and sole reliance on "one mouth, two legs" can in no way catch up to the third or fourth waves. When I went to the borders of Yunnan I discovered that scientists and technicians along that strip have not increased much since the 3d Plenum of the 11th Central Committee, and many have even moved away. Those who have not left are still looking for opportunities to do so. In addition, many couples have lived in separate dwellings for a long time, and they say: "There are only one herdboy and a spinning girl in heaven, and even that is a fabrication; but here on earth there are a great many herdboys and spinning girls in S&T departments." Some provisions call for 20 years of service and a rank of agronomist or engineer before the husband or wife can transfer to be together. They say: "How many 20-year periods can there be in a life!" Some have even said: "These are not humane provisions."

The Central Committee long ago pointed out that the focus of economic construction will gradually shift toward the northwest and southwest, as well as to the numerous mountain areas and remote areas. For that reason, however, the work to improve the spiritual and material lives of scientists and technicians in those regions should be started as soon as possible. Some comrades feel that remuneration for scientists and technicians should not necessarily be "uniform throughout the nation." The more arduous an area, the higher could be the wages.

Here, I may strongly reflect that in our current reforms of wages, there is an emphasis on "directors," whose wages have risen with each remuneration for administrative leadership, not for "skilled persons." But regarding this problem of remuneration for scientists and technicians who are in grassroots level work but who have genuine talent, this has not been handled reasonably enough. Formerly, there was a tradition in intellectual circles of being happy amidst poverty, but the spirit of the day appears to be to encourage people to secure official positions. This will subtly affect the self-respect of intellectuals.

#### V. Regarding the Problems of Bringing in S&T Talent and of Their Outward Flow

Over the past few years, I have met with many scientists and technicians both here and abroad, both at the grassroots level and also those of Chinese ancestry. The bringing in of talent, and especially the outward flow of that talent, has proven to be a sensitive question. Whether in the United States or in Europe, I have discovered that there are many patriotic scientists who truly want to return to this country to work toward the "four modernizations." Some have said to me quite excitedly: "In the past there was no alternative but that we were forced to be dependent upon others. Now we must contribute to the invigoration of China before we can be without shame among our ancestors." Some feel that being second-class citizens in the United States, or even third-class citizens (even lower than blacks), is not as good as "going back home." Consequently, their regret is that owing to certain historical consequences, together with an insufficient understanding of the new domestic situation, they still have lingering fears that after they had returned to China there would be no scope for their abilities, and they would

be slow in advancing. At the same time, there were also some students who had recently come out of China for study who, seeing how good the working conditions are there, did not plan to return to China, which is well worth our attention. I also exchanged opinions with old friends of mine who now live abroad. They all have great hopes for the restructuring of the science research and education systems and hope that more "enlightened persons" with certain levels of attainment and courage and insight will be invited to assume leadership positions. They all felt that since the Third Plenum, the positions of scientists and technicians have been visibly improved, but to make full use of their potential and enthusiasm, they will have to be allowed to ascend another level. Some even said that as long as their conditions were good and their work was good, whether they are specialists from China living abroad or specialists and technicians living in Taiwan Province, they would return home with pleasure.

At the same time, there were also several scholars of Chinese ancestry who said to me that the People's Government should not encourage scientists who can do research to go into administration. There are many ways to respect science and respect scientists and to improve their living standards and improve their social status. They say that when some countries revere scientists, it is just like revering "kings," and our treatment of specialists who have made truly outstanding contributions should be well publicized in commendations to improve their positions in scientific circles and in society. This will encourage the enthusiasm of other scientists and technicians, but we need not use official positions in government to encourage them, which is a feudal vestige where "those good at study will become officials." They said that "For a true scientist, even if you wanted them to be president they would not do it."

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## NATIONAL DEVELOPMENTS

### S&T, EDUCATION REFORMS DISCUSSED

Beijing XIANDAIHUA [MODERNIZATION] in Chinese No 9 Sep 86 pp 12-13

[Article by Lu Yongxiang [6424 3941 4382]: "Some Ideas Regarding the Restructuring of the Overall Structures and the Microcosmic Structures in Education in this Country"]

[Text] The successive promulgation last year of the Central Committee's "Resolution Regarding the Restructuring of the Science and Technology System" and the "Resolution Regarding the Restructuring of the Education System" have clarified the directions for the restructuring of the S&T and education systems in this country. In accordance with the correct principles proposed in the two "Resolutions," the speeding up of the restructuring of the S&T and education systems in this country is a major topic worth the attention and study of our comrades working at the frontlines of S&T and education.

I would like to present some tentative ideas regarding this topic, and if in so doing I can attract attention and discussion from all areas, and offer some introductory remarks to stimulate the valuable opinions of others, then I will have attained my goal.

#### I. Establish New Systems in Which Education and S&T Are Closely Allied in Ways That Suit Our National Conditions

Science research is the process through which mankind understands nature and society, by which it explores its laws, and by which it tames and transforms nature and society. Education, then, is the process through which we transmit cultural knowledge and develop science and technology, by which we train and employ a professional laboring army and specialist S&T talent 1 billion strong that has its ideals, is cultured, has its morality, and is disciplined. Science research organizations concentrate various types of specialists, have excellent research equipment, engage in various science research, and should constitute an important base for training and fostering high-level specialty talent; colleges concentrate the majority of high-level specialized talent throughout the nation, have a full complement of disciplines, have broad contacts both within and outside, and have abundant raw strength. They are also a considerable reserve force that at the same time as it is engaged in teaching constitutes an important base for science research. The close integration of science research and education not only benefits the

development of science and technology, but is also better for training the new generation, for whom theory is concerned with reality and which has a creative spirit. This is also one of the experiences in the success of developed countries.

However, due to historical conditions that have existed for some time in this country, the education and S&T systems are fundamentally separate. The Chinese Academy of Sciences, the Chinese Academy of Social Sciences, the Chinese Academy of Agricultural Science, the Chinese Academy of Medicine, as well as institutes and organizations affiliated with the ministry commissions and the provinces and cities only train a few graduate students. Although higher institutions in this country have brought together more than two-thirds of the teachers and S&T personnel who have high-level posts and more than two-thirds of those who have left the country for further study, they have only undertaken a quite disproportionate science research tasking. The disparity between talent and funding not only affects the pace at which our science and technology develop, but also affects the training and maturing of the new generation of S&T talent, creating an enormous waste of talent and funds. This is a developing nation and we are not rich in either funds or talent, so even more should the two be closely integrated to seek the greatest results from investment. Consequently, although this abuse has been recognized long ago by many people, the steps to restructuring are very difficult. I believe that if we are to strengthen the closer integration of education and science research, we can begin from the following aspects: first of all, all departments and local governments, and even the leadership of all enterprises, should be fully aware of the new characteristics of the integration of science research with education, and should adopt various policies and measures to guide and promote the constant intensification of this kind of integration through means such as organizing and combining research to solve problems, integrating the running of schools and institutes, integrating the training of graduate students, and integrating the absorption and development of imports with the secondary jobs of personnel. Second, reasonably apportion research funding for higher institutions, and in a planned way, fund and construct a group of major laboratories at certain major higher institutions, and open up the laboratories and institutes and research offices to strengthen the means and equipment for science research at higher institutions. Third, all major higher institutions should actively strive to run their schools as centers for both teaching and research. As they complete their teaching mission, they should actively develop basic research of a rather high level, and should take the initiative in taking on research projects and problem-solving tasking that is of major significance to the national economy and to socialism, and that will serve our four modernizations. Fourth, I recommend that the Central Committee strengthen its unified leadership of the restructuring of the education and S&T systems, that it quicken the pace of reform, and that it establish a new system with Chinese characteristics that closely integrates education and science research.

## II. Rapidly Change the Divisions Within the Science Research System in This Country and the Attitude of Every Person for Himself; Strengthen the Capacity of Enterprises To Do Research and Development; Prepare To Establish the Chinese Academy of Engineering Sciences

Other drawbacks in the overall science research system in this country include divisions, disparate funding, top-heavy, and unbalanced proportions. Because provinces, cities, ministries, and commissions each have a group of research academies and institutes, which form systems among themselves, this leads to duplicate funding for equipment, low-quality duplication of research topics, no communication of information, and many difficulties for cooperation in problem solving. This situation seems to have worsened in recent years. No investment outside a system and no outward flow of "nutrient-rich water" become commonplace principles. Therefore, it is hard for the science research funding system to be truly implemented and it is always changing its form. This has seriously affected the results of science research funding in this country, has obstructed the rational movement of personnel, and has made the already extremely limited S&T talent in this country unable to achieve a reasonable exploitation and use of talent.

In this science research system with its divisions, it has also been difficult to realize adjustments of overall science research hierarchies and structural reform. Governing departments are invariably hampered by the traditional concepts of small production and the partial benefits to the particular department or system. They do not consider rational science research hierarchical structural models for the entire country and particular conditions. There is mutual wrangling, striving for scale, for hierarchies, for investment, and they ardently go no further than "small" or than "large," all of which leads to the current situation that is top-heavy and disproportionate, where enterprise capacities for developmental research are weak, where administrative levels are disproportionate, and where the dissemination and application of science research achievements and the progress of their transformation into production forces are slow. This is neither in keeping with the characteristics of the high degree of the division of labor and the high degrees of comprehensive development, but neither does it accord with the national principles by which science research will cater to economic construction. We should adopt resolute measures that after reasonable adjustments can rapidly change this situation. All science research organizations in this country should be separated from government administrative leading departments, and through gradual reform and adjustment this will lead to the existence in this country of only four models for research organizations: national laboratories; national or regional science research organizations; enterprise affiliated research organizations; and institutes and laboratories affiliated with colleges.

Only national laboratories are suited to investment in very large science research equipment, as for example high-energy accelerators, space laboratories, nuclear energy research laboratories, and giant wind tunnels, which should be available to the entire country; in addition to the existing Chinese Academy of Sciences, the Chinese Academy of Social Sciences, the Chinese Academy of Agricultural Science, and the Chinese Academy of Medical Sciences, as far as another national science research organization is

concerned, we can consider the establishment of the Chinese Academy of Engineering Sciences. Institutes to be affiliated with it could be chosen from the institutes and academies affiliated with the existing Chinese Academy of Sciences, colleges, and ministries and commissions where there are better conditions, adjusted and enriched, and for which there would be a scientific and rational division and distribution of labor. At the same time, we could adjust and enrich a number of existing research organizations that are affiliated with ministries, commissions, provinces, or cities or with the Chinese Academy of Sciences, as well as some scientists and technicians at colleges, making them into research and development centers for medium to large enterprises, or could establish independent, regional specialized technology research organizations. Through science research planning and science research funds, the state can accomplish the overall regulation of science institutes and laboratories, and can also adopt effective reform measures, as for example with legislation and tax revenues, to promote enterprise investment in science research and development, which will strengthen the R&D capacities of enterprises.

### III. Adopt Strong Measures To Enhance Overall Control and To Adjust the Hierarchical Structures of Our Nation's Educational System

In recent years, party and governmental leadership departments at all levels and in all areas have paid attention to knowledge and have respected talent, and the enthusiasm for running schools is quite high. This is in itself a good thing. However, what is worth noting is that there is another tendency in the current trends involved with running schools: some places and departments, as well as some schools, pay no heed to their own conditions and to objective needs, and in their hurry to improve the standards for running schools, many schools have changed their names to "colleges" one after the other. According to statistics from the State Education Commission, there are now 1,016 higher institutions throughout the country, some 200 more than at the beginning of 1985. In situations where teacher wages and equipment are not yet fully available, some schools have rushed to accept graduate students, have applied for the authority to confer MS and PhD degrees, and are improving the hierarchies for running schools. The number of graduate students enrolled throughout the country has grown abruptly, where in 1986 there have already been more than 45,000 admitted to masters programs throughout the country. If this is not controlled, it is estimated that after implementation this year of a professional hiring system and approval of the Third group of units with degree conferring authority, there will be even more growth. In another aspect, the colleges, technical secondary schools, and technical engineering schools so urgently needed in this country have developed at an unsatisfactory pace. Youth currently entering school will determine the structures and quality of our labor force at the end of the 20th century, and will also determine the level of our social and economic development for the same period.

Therefore, I believe that we should now adopt strong measures to enhance overall control, and to adjust as early as possible the structure of administrative levels for the educational system in this country.

If we are to formulate appropriate policies and arouse enthusiasm in all areas, especially in making the most of the enthusiasm of enterprises for running schools, we can change the majority of ordinary middle schools into professional middle schools or middle-level vocational schools as quickly as possible. And we can reform the teaching philosophies and content of ordinary middle schools, shifting from a focus on preparation for promotion in school to an equal concern for promotion and employment. Naturally, because of difficulties with teacher wages, equipment, and locations for practice, to implement these kinds of changes by sole reliance on the efforts of government education departments would make it hard to achieve. If we combine enterprises with education departments, make the most of each of their good points, it will be possible to easily come to a resolution of the problems of teacher salaries, equipment, and the restructuring of funding.

The State Education Commission has determined that this year there will be no more schools allowed to start up, which is completely correct. Aside from this, I believe that there should be a consolidation of our existing 1,016 higher institutions. Schools that are blindly upgraded should make use of practical measures to carry out adjustments and enrichment. I urge that under the prerequisite of ensuring the quality of running schools, we should coordinate the development of scope in a stable manner, and add different disciplines in accordance with national needs. We should emphasize the development of administrative levels for colleges, and quickly improve their proportions in personnel structures.

We should at present also pay attention to the quality of graduate students, and at the same time as we appropriately control the pace of development, should go on to adjust the proportions of disciplines and develop rare science categories that are urgently needed. In addition to this, we should strictly control the number and distribution of units with authority to confer degrees, as well as establish academies and schools for graduate students. And I recommend that through annual adjustments we have a system whereby authority to grant degrees is only present in higher institutions and where the authority to grant degrees to doctoral students be rather concentrated in major universities at the first level of fewer than 100 schools throughout the country. This will promote the association of institutes and higher institutions in the training of graduate students and their cooperation in carrying out science research. This is also a widespread experience of developed countries.

#### IV. Some Problems With the Restructuring of Microcosmic Structures of Relevant Science Research Organizations

##### A. The Selection and Terms of Scholastic Leaders

Institute directors are different from general administrative heads, for they should be academic leaders foremost, who can adroitly take control of the directions of development for a particular discipline. At the same time, they are also the organizers and leaders of science research, who can effectively organize and guide S&T personnel, make the most of their collective wisdom, and join in carrying on scientific research. For this reason, only talent of a high scholastic level, of a strong enterprising spirit and a capacity for

organization, and of a high ideological and moral integrity can assume those tasks and carry out the system of tenure. Because science research requires long-term accumulations and constant innovation, This is not the same as the characteristics for organizations in the production process regarding periods and repetition. Therefore, scholastic leaders (directors of research offices), aside from their strict selection, should be as stable as possible, which is not suitable for carrying out short-term tenure like that of general administrative posts, which are regularly changed. If there is fear that a selection might be inaccurate, there could be a 2- to 4-year trial appointment. After the trial appointment has been satisfactory, it would then change to a stable term of employment, and would be provided with appropriate personal authority, financial authority, and academic leadership authority to allow for the establishment of disciplines and for long-term planning; to guide and organize scholastic echelons, and to strive to catch up with and surpass advanced standards both within this country and outside it.

#### B. Establish an S&T Contingent of Rational Specialized Structures

Modern science and technology are characterized by a comprehensive overlapping. A single specialty structure is already very difficult to meet the demands of modern science research institutes, and it is impossible for irrational proportions for administrative levels to have higher research efficiency. That will only bring on unnecessary internal consumption and the waste of talent where higher level materials are used poorly. Therefore, science research contingents should have reasonable specialist structures and administrative level structures to make the most of the advantages of multiple disciplines in solving problems and to enhance the capacity for science research to overcome difficulties.

#### C. Establish Highly Effective Science Research Assistance Contingents

To ensure the highly effective operation of science research organizations, and in accordance with contemporary social conditions in this country, science research organizations should establish contingents to provide highly efficient research assistance and serve as technical reserves. For example, secretaries, laboratory personnel, programmers, materials personnel, etc. For reasons owing to current policies, science research assistance contingents generally have problems with poor quality and instability. At the same time as we enhance professional training, we should strengthen ideological and political education, and should appropriately adjust wage policies, posts, and remuneration in order to allow a fondness for a particular job and a loyalty to it.

#### D. We Should Permit the Reasonable Movement of Scientists and Technicians

Science research is a process of constant innovation and exploration, and engagement in science research is not the same as general social occupations. Science research contingents require constant maintenance of vitality and vigor, and the constant introduction of new ideas and new people. For this reason, the movement of personnel is a necessary condition for maintaining the vigor of science research vigor. Many science research organizations abroad have systematic provisions regarding the movement of talent. In this country

the movement of personnel has been talked of for several years, but has been difficult to achieve. I believe that the key to the problem is in the determination to restructure. As long as there is that determination, the following two provisions are attainable: 1. make the full use of graduate students as echelons of movement for science research; 2. whether or not the state can first clarify its provisions to permit research personnel at mid- to high-levels in science research and teaching organizations to move reasonably within a certain regional scope.

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## NATIONAL DEVELOPMENTS

### OFFICIAL URGES RELAXATION OF S&T POLICY FOR INDEPENDENT UNITS

Beijing RENMIN RIBAO in Chinese 20 Nov 86 p 3

[Article by Chen Zujia [7115 4371 3946]: "We Will Relax Policies Toward Economically Independent Research Units"]

[Text] How are science research units engaged in developmental research to restructure in the next step? Director Zhang Guoyu [1728 0948 3768] of the Tianjin Municipal Textile Institute stated in an interview with reporters recently that developing the integration of science research with production to promote economic independence is a necessary path for restructuring developmental institutes and the S&T system.

Why does he speak this way? Zhang Guoyu explained with the following reasons: the goal of restructuring the S&T system is to promote the integration of S&T with the economy, which will allow science research achievements to more quickly be transformed into products and commodities and to develop into production forces. The state wants our developmental institutes to begin using compensated contracts, to gradually cut operating expenses from the budget, to put compensated transfer of rights to technology into effect, and be economically independent, all to attain this goal.

We can see from actual practice over these few years that technology markets have sprung up all over the country, and have provided beneficial conditions for technical achievements to become commercialized. But there is not a uniform understanding of technology markets, and many enterprises insufficiently understand the strategic position of the development of new technologies, and some lack a capacity for acceptance. At the same time, some science research units have not completely traversed the full process of science research and have turned out some immature technologies, the result of which has been conversely to block the transformation of S&T achievements.

Zhang Guoyu believes that viewed from the current situation, since only some 300 developmental science research units have become economically independent throughout the country, the goal by which we wish to implement economic independence within 3 to 5 years will certainly not be an easy matter. It is not realistic to rely solely upon the compensated transfer of the rights to technologies to obtain the income by which to realize economic independence. Even reliance upon processing, manufacturing, and sales by experimental plants

for experimental products is not a long-term plan. Only by developing lateral associations and allowing the close integration of science research with production can we ensure economic independence.

In recent years, the Tianjin Textile Institute has made some explorations of the integration of science research and production. They began with loose associations, giving assistance to some factories and plants in areas such as Baoding and Kaifeng to develop new products, which allowed these factories and plants to turn losses into gain. Later, these developed from bipartisan joint planning, design, and development into shared achievements and shared distribution of results. Currently, they have formed close associations regarding technical, materials, technique, equipment, and personnel aspects together with more than 10 enterprises in areas like Tianjin, Hebei, Jilin, and Zhejiang. This kind of association has allowed enterprises to develop, institutes to add results, and has laid the foundation for economic independence.

Zhang Guoyu appealed to relevant departments to go further in relaxing their policies toward associations and toward economically independent science research units. He said that after economic independence, tax revenue and surcharges would increase accordingly, and their burden will in fact be much greater than for units for which operating expenses have not yet been cut. This lack of regard for the characteristics of science research units, this beating of an already fast ox on the pattern of treatment of enterprises is of no benefit to the restructuring of the S&T system. There are currently some that currently take a wait-and-see attitude toward the restructuring of the S&T system, that feel that keeping up the status quo is better than economic independence, that "eating the royal grain" is both free and easy and also has its guarantees, which are their reasons. We hope that the policies regarding the restructuring of the S&T system as promulgated by pertinent departments will be complete ones, and that they will provide preferential conditions for restructuring units that will allow everyone to get on the road to the budgetary elimination of operating expenses as quickly as possible.

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## NATIONAL DEVELOPMENTS

### NATION'S ACHIEVEMENTS IN REMOTE SENSING TECHNOLOGY RECAPPED

Beijing BEIJING KEJIBAO in Chinese 1 Dec 86 p 3

[Article by Zhu Pinghua [2612 5493 5478]: "Discussing China's Remote Sensing Technology from the Point of View of the Model U-2 Reconnaissance Aircraft"]

[Text] In 1965 we shot down an American U-2 high-altitude pilotless reconnaissance aircraft. Over the intervening 21 years, this affair has been largely forgotten and would certainly not lead people to realize the start that this U-2 reconnaissance aircraft brought to remote sensing technology in this country.

Remote sensing technology is a technical field where various kinds of sensors are used to receive electromagnetic information from the various surface features of the earth's surface, and then to process and handle this information, thereby probing and distinguishing different surface features and their characteristics from long distances away. It is a comprehensive applied technology built upon the foundation of optics, infrared technology, microwave technology, radar technology, laser technology, holographic technology, electronics, computer technology, control theories, and information theories.

Remote sensing began during World War I in the United States. In the early 1960's, the United States placed infrared instruments into space machinery for use in military reconnaissance. As American military technology improved, some instruments were gradually transferred to civilian use through obsolescence, and remote sensing technology began to be broadly used in many aspects such as agriculture, forestry, geology, hydrology, the oceans, meteorology, and ecology. In the early 1960's, American remote sensing technologists proposed the phrase REMOTE SENSING, directly translated as "remote sensing."

Beginning in the 1950's, we were already doing aerial photography. Infrared studies began in 1965. In January 1965, we shot down an American U-2 high-altitude pilotless reconnaissance aircraft. The Shanghai Institute of Technical Physics analyzed and copied the infrared instruments on board. From that time on, the task of remote sensing made real progress in this country.

In 1974, we held our first infrared conference, after which the number of remote sensing technology applications research units gradually increased, and some advanced foreign instruments were imported, and we set to work on

development. In 1978, we made our first large-scale remote sensing comprehensive investigation in Tengchong County, Yunnan. This large-scale comprehensive investigation went on for 2 years, with 706 scientists and technicians from 68 units from 16 ministerial commissions and offices throughout the country taking part. This investigation made use of the first remote sensing equipment developed in this country at that time, and accomplished its predetermined objectives, from which were obtained the first group of achievements. In recent years, we have launched more than 10 satellites, and have successfully launched and recovered S&T experimental satellites, from which we have obtained some graphics and data on earth resources. This summer our land satellite ground station began operations. From it, we can receive and redistribute the multiple spectrum scans and special mapping instruments image data from the American LANDSAT. And we can also go on to receive data from the French SPOT satellite. The remote sensors that we have designed in this country include multiple-spectrum cameras, multiple-spectrum scanners, multiband infrared scanners, CCD cameras, microwave radiometers for different bands, scanning microwave radiometers, and true aperture and composite aperture side-looking radars. Those, like imaging spectrometers, have undergone various experimental applications and are developing into practical systems. The Institute of Remote Sensing of the Chinese Academy of Sciences has developed the IRSA-2 remote sensing map-processing technology with excellent processing features. Units from the Huabei Institute of Computing of the Ministry of Electronics and from Qinghua University have each developed small- to medium-scale digital mapping processing systems. And at the same time we have begun to undertake development of microprocessor-based digital mapping processing systems.

In this country, remote sensing technologies have been used in territorial renovation, urban planning, railway track selection, catastrophic weather monitoring, environmental monitoring, agricultural-yield estimation, forest cover, coastal changes, and natural resource exploration, which have fully displayed their important function in national economic construction and in people's lives, and have been broadly applied in the sectors of agriculture, forestry, water conservancy, surveying and mapping, geology, space navigation, nuclear industries, railways, and meteorology. For example, in 1985 the Remote Sensing Applications Institute of the Chinese Academy of Sciences took on an investigation of the current utilization status for the Xizang Autonomous Region. The surface area of the Xizang Autonomous Region is 1.22 million sq km, the population is 1.8 million, and has an average altitude of 4,500 m above sea level. In this complex terrain that is sparsely inhabited, investigating with normal methods would be very difficult. By using various space remote sensing materials, it is estimated that the investigation can be completed by 1990. Or where the Chengdu Geographic Institute has made use of spectral reflection characteristics in the Wanglang natural protected region to monitor *Sinarundinaria nitida* of different growth periods and to forecast bloom times for *S. nitida*. This will be very beneficial to protecting the wild and precious panda. Also, we have serious losses from erosion and water conservancy departments are using remote sensing mapping to divide the soil erosion conditions in regions of the Yongding He with government offices and above into 15 categories, and erect water and soil conservation projects in regions with serious erosion losses in order to bring them under control. This method has been started full scale around seven large rivers and

continental river drainage areas. With help from the National Weather Bureau, fishing industry companies have used weather satellites to observe ocean surface temperatures and analyze ocean current gradients to seek fishing grounds. Last year, this enabled the winter catch to be significantly higher than that of previous years of the same period.

Remote sensing technology in this country, speaking from an overall perspective, is still some distance from advanced international levels, but its uses have shown its broad future for development. China's well-known optics researcher Wang Daheng [3769 1129 3801] has called remote sensing technology the "taking of a broad and long-term view."

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## NATIONAL DEVELOPMENTS

### ANTICHEMICAL WARFARE CONFERENCE HELD IN LANZHOU

Lanzhou GANSU RIBAO in Chinese 16 Nov 86 p 1

[Report by Yan Siyuan [7346 1835 3293], Ma Deju [7456 1795 1446], and Qin Lidang [4440 0500 8093]: "All-Services Anticongital Warfare Technology Conference Held in Lanzhou"]

[Text] How are military science research and technology going to keep up with the new situation regarding socialist modernization? The all-services antichemical warfare technology conference that ended in Lanzhou on 15 November proposed: continue to serve the troops, serve society, serve the building of national defense, and the building of the national economy.

To meet the demands of socialist modernization, some of the military science research and technology units among the troops with abundant technical strength should actively serve socialist modernization, under the prerequisite that they manage the troop activities well. Many science research units and technology departments have moved to strengthen lateral relations with relevant units that are local and in science research and education. They are joining to overcome S & T difficulties, and have obtained excellent economic and social results. Beginning in 1985, every technical research institute in the Lanzhou military region established broad-based technical relations with more than 10 research units in Gansu Province, which have gained outstanding results.

The all-service antichemical warfare technology conference began 11 November in Lanzhou. Tens of antichemical warfare technical specialists from each Army region, the Air Force, the Navy, and the Second Artillery took part in the conference. The conference summed up and exchanged experiences in all-service antichemical warfare technology, and the record of the Lanzhou Military Region work in antichemical warfare technology was well praised by attendees. During the meeting, the deputy commander of the Lanzhou Military Region, Ma Weizhi [7456 0251 1807], Deputy Commissar Pei Jiuzhou [5952 0046 1558], and Chief of Staff Xing Shizhong [6717 0013 1813] visited with the representatives.

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## NATIONAL DEVELOPMENTS

### BRIEFS

FUJIAN 'SPARK PLAN' UPDATE--In 1986, Fujian Province put into effect more than 200 "Spark Plan" projects, some of which have already begun to show results. The Pacific Ocean demonstration project for the growing of suspended oysters carried out by the island Dongshan County was reviewed for acceptance in November 1986. The first bumper harvest was reported for 37 mu of oysters, the yield averaging nearly 1,000 kgs per mu of fresh oysters. Fujian also made use of its large amounts of mountainland tree twigs and otherwise worthless bits of wood, wood shavings, and bagasse for the growing of edible fungi. This item has now been made a part of the "Spark Plan" and has been spread to 29 counties in 7 prefectures (or cities) throughout the province. Total investment has amounted to 10 million yuan, making this a newly developing major industry in rural Fujian Province. In 1986, the province produced 8,000 tons of dried mushrooms [*Lentinus edodes*]. [Text] [Beijing KEJI RIBAO in Chinese 20 Feb 87 p 1] 9432

CSO: 4008/2079

PHYSICAL SCIENCES

PLANE TILING WITH CONVEX PENTAGONS

Shanghai ZIRAN ZAZHI [NATURE JOURNAL] in Chinese Vol 9, No 5, May 86 pp 363-368

[Article by Liu Weihan [0491 4850 5060] of the Shanghai Television University]

[Abstract] Tiling occurs in many mosaic patterns of newly unearthed antiques and in modern arts. This is a field where wisdom, skill and inspiration are relied on, more than mathematical formal training. Thus, amateur mathematical buffs have just as much an opportunity in contesting with professional mathematicians in solving tiling problems. This article stems from the column "Mathematical Games" by Martin Gardner in SCIENTIFIC AMERICAN magazine. In his July 1975 column, a problem many mathematicians were studying for more than 5 decades was raised, "Plane Tiling With Convex Pentagons." A computer scientist Richard James, III and a San Diego housewife Marjorie Rice designed, respectively, one and four new patterns for tiling with pentagons, while professional mathematician R.B. Kershner and D. Schattschneider provided the necessary explanations in the formal mathematical discipline. In particular, the housewife made such interesting discoveries that professionals were left feeling baffled.

Eleven diagrams show eight types of tiling with convex pentagons, James' discovery, Rice's compilation of nine convex-pentagon types, her symbol representation, her four discoveries, her disproof of Schattschneider's hypothesis, a new tiling pattern of the first-type pentagons, and nine methods of dividing a double-hexagon into four pentagons.

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10424/6091  
CSO: 4009/1071

PHYSICAL SCIENCES

MICELLE SPECTROPHOTOMETRIC DETERMINATION OF TRACE QUANTITIES OF ZIRCONIUM  
WITH n-UNDECYLFLUORONE, CETYLTRIMETHYLLAMMONIUM BROMIDE

Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 14, No 11,  
20 Nov 86 pp 838-841

[Article by Zheng Yongyi [6774 3938 3556] and Li Xiaoqiang [2621 2556 1730]  
of the Department of Chemistry, Qinghua University]

[Text] Among surface active agents, there are reports of the use of trihydroxy fluorone type color developing agents for the micelle spectrophotometric determination of zirconium. We, ourselves, have synthesized a new type of trihydroxy fluorone reagent--2,6,7-trihydroxy-9-n-unidecylfluorone (denoted UF). This is another substituted fluorone which has alkylation at the ninth position (no aromatic groups) and its hydroxyl bond lengths are moderate. We have researched the three component color developing system of Zr(IV)-UF-CTMAB. Experiments indicate that this system is highly sensitive for the determination of zirconium, the color development is compatible with a broad range of acidities, and also it has very good selectivity without addition of screening agents or separation steps. It can determine trace amounts of zirconium in zirconium bronzes and in the presence of aluminum alloys. The method is simple and fast.

I. Instrumentation and Reagents

Hitachi model 340 ultraviolet/visible/near-infrared spectrometer.

Zirconium standard solution: Dissolve spectral grade  $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$  in 2M HCl and prepare a stock solution of 1.000 mg/ml zirconium, then dilute twice with 2M HCl to prepare a working solution with a zirconium content of 10.0  $\mu\text{g}/\text{ml}$ .

0.05 percent UF in ethanol solution: Dissolve self-prepared UF solid in 95 percent ethanol (include a small amount of hydrochloric acid; 2 ml of 2M HCl/250 ml), to give an 0.05 percent solution.

$1.0 \times 10^{-2}\text{M}$  cetyltrimethylammonium bromide (CTMAB, Beijing Chemical Works) aqueous solution; (crystallization occurs at low room temperature; may be kept in a slightly heated water bath to maintain dissolution).

## II. Basic Operating Procedures

In a 25 ml colorimetric cylinder, add 10 g of Zr(IV) solution, 1.5 ml of 2M HCl, 4.0 ml of  $1.0 \times 10^{-2}$  CTMAB solution, and 1.0 ml of 0.05 percent UF ethanol solution. Add water to volume and shake to mix. Let stand for 10 minutes, then scan with a model 340 spectrophotometer, or select 515 nm, and determine the absorption of the coordination complex with a 1 cm solution cell using the appropriate reagent blank for comparison.

## III. Experimental Results and Discussion

### A. Absorption Spectra of the Reagent Blank and the Coordination Complex

From Figure 1 it can be seen that the greatest absorption of the red tertiary coordination complex occurs at a wavelength,  $\lambda_{\text{max}}$ , of 515 nm while the corresponding  $\lambda_{\text{max}}$  of the reagent blank is at 460 nm.

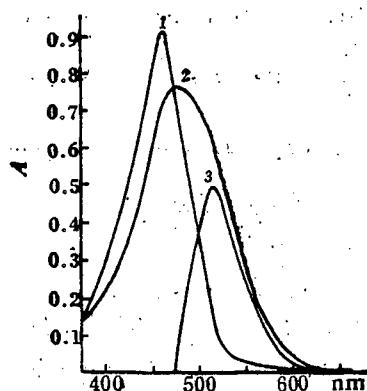


Figure 1. Absorption spectra of the reagent blank and the coordination complex

1. UF-CTMAB--UF:1.0ml(0.05%); CCTMAB =  $1.6 \times 10^{-3}$ M;  
reference: water
2. Zr(IV)-UF-CTMAB--Zr(IV):10 $\mu$ g/25ml; all else as above
3. Zr(IV)-UF-CTMAB--reference: reagent blank; all else as above;  
0.20M HCl; 1 cm solution cell

### B. Effect of Acidity on Color Development

Experiments indicate that a suitable acidity range for the color development system is 0.16 to 0.32M hydrochloric acid. At acidities above and below this range, the absorption decreases.

### C. The Effect of Surface Active Agents

Past experiments have compared the effect on the Zr(IV)-UF color developing system of anionic surface active agents (dodecyl sodium sulfate), non-ionic surface active agents (emulsifiers OP and Tween-20), cationic surface active

agents (CTMAB), and mixed anion-cation surface active agents (dodecyl sodium sulfate and various alkyl trimethylammonium bromides) and the results show that the solubility enhancement and the increased sensitivity of CTMAB is the best. Moreover, the acidity of color development is the highest and the reaction is fast. Further research shows that at a concentration of CTMAB in the range of  $8 \times 10^{-4}$ M to  $1.8 \times 10^{-3}$ M the absorption of the coordination complex is both strongest and most persistent. At very low CTMAB concentrations ( $C_{\text{CTMAB}} < 8 \times 10^{-4}$ M) the reagent blank becomes turbid; moreover, in the area of 550 nm a stronger absorption band appears. At the same time, the coordination complex solution has a definite degree of turbidity. This, then, affects the measurement of the absorption. At high concentrations of CTMAB ( $C_{\text{CTMAB}} > 1.8 \times 10^{-3}$ M), the absorption of the coordination complex is totally decreased (see Figure 2). We chose a CTMAB concentration of  $1.6 \times 10^{-3}$ M.

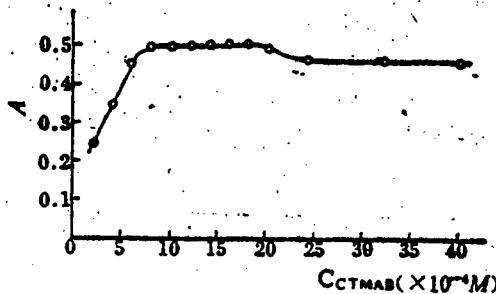


Figure 2. Effect of CTMAB concentration

Zr(IV): 10 $\mu$ g/25ml, UF: 1.0ml(0.05%), [HCl]=0.20M, reference: reagent blank,  $\lambda = 515$  nm, 1 cm solution cell

#### D. Effect of the Amount of Color Developing Reagent Used

Experiments show that 0.9 to 1.5 ml of color developing reagent (0.05% UF) is a suitable amount to use (see Figure 3). When larger amounts of UF are used, turbidity occurs in the reagent blank and in the area of 550 nm a stronger absorption band appears, making the absorption at 550 nm much reduced and its value cannot be determined with accuracy (see the dotted line section of Figure 3). We chose to use 1.0 ml of 0.05% UF.

#### E. Effect of the Sequence of Reagent Additions on Color Development

In the reagent system, CTMAB must be added first, and afterwards add UF, otherwise the UF may precipitate and there is difficulty with agglutination upon addition of the CTMAB. The sequence of addition of the other reagents has no effect on the absorption. This color development system is very fast, within 10 minutes. The absorption and stability are at their maximum values and the system is stable for at least 6 hours.

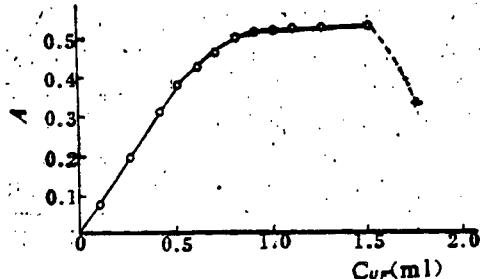


Figure 3. Effect of amount of UF used

Zr(IV):  $10\mu\text{g}/25\text{ml}$ , CCTMAB =  $1.6 \times 10^{-3}\text{M}$ , [HCl] = 0.20M, reference: reagent blank,  $\lambda = 515 \text{ nm}$ , 1 cm solution cell

#### F. Working Curve

Taking different amounts of Zr(IV) standard solution, we constructed a working curve following basic operating procedures. Experiments show that with zirconium in the range between 0 and 12  $\mu\text{g}/25 \text{ ml}$ , Beer's law is followed. From the slope of the working curve, the apparent molar extinction coefficient of the tertiary complex,  $\epsilon_{515}$ , is  $1.1 \times 10^{51} \cdot \text{mol}^{-1} \cdot \text{cm}^{-1}$ . It can be seen that the sensitivity of zirconium determination by this method is very high.

#### G. Interference by Other Substances

It can be seen from Table 1 that within an error range of  $\pm 3$ , except for niobium, molybdenum and tungsten and a few other multivalence metallic ions, the other common metallic ions, even present in large quantities, do not interfere in the determination of zirconium. Relatively large amounts of trivalent ferric ion in ascorbic acid can be tolerated. Just fluoride ion, oxalic acid, and EDTA have a screening effect and should be avoided.  $\text{H}_2\text{O}_2$  can oxidize UF and fade the color; it must be eliminated.

#### IV. Use of the Method

Since this method has quite good selectivity with regard to the common metal ions, there is the possibility of running it under conditions without any separation and without adding screening agents for the direct aqueous determination of trace quantities of zirconium in alloys. It can be used for the determination of trace quantities of zirconium in aluminum alloys and zirconium bronzes with satisfactory results.

Operating procedures: Weigh out 0.1000 g of an alloy sample and place in a 50 ml beaker, cover the surface, add 10 ml of concentrated hydrochloric acid, heat slowly on an electric hot plate, afterward add 30 percent  $\text{H}_2\text{O}_2$  in drops. After the sample decomposes, evaporate until its volume is 2-3 ml to eliminate  $\text{H}_2\text{O}_2$ . After cooling, add 6 ml of concentrated hydrochloric acid and quantitatively transfer to a 50 ml volumetric flask, add water to volume, and shake. Draw 1.00 ml of the test solution and according to basic operating procedures develop the color. Determine the absorption and get the zirconium content of the sample from the working curve as in Table 2.

Table 1. Common Ion Interference (Zr(IV):10 $\mu$ g/25ml;  $A_0=0.485$ )

| (1)                          | (2)         | (3)                               | (4)   | (5)                | (1)                              | (2)         | (3)                             | (4)   | (5)                |
|------------------------------|-------------|-----------------------------------|-------|--------------------|----------------------------------|-------------|---------------------------------|-------|--------------------|
| 干扰物质                         | 加入量<br>(mg) | 加入形式                              | 吸光度A  | 测得锆量<br>( $\mu$ g) | 干扰物质                             | 加入量<br>(mg) | 加入形式                            | 吸光度A  | 测得锆量<br>( $\mu$ g) |
| Al <sup>3+</sup>             | 5.0         | AlCl <sub>3</sub>                 | 0.489 | 10.1               | Fe <sup>3+</sup>                 | 0.10        | FeCl <sub>3</sub>               | 0.485 | 10.0               |
|                              | 8.0         |                                   | 0.500 | 10.3               |                                  | 0.30        |                                 | 0.512 | 10.5               |
| Ba <sup>2+</sup>             | 10.0        | BaCl <sub>2</sub>                 | 0.489 | 10.1               |                                  | 5.0*        |                                 | 0.485 | 10.0               |
| Ca <sup>2+</sup>             | 5.0         | CaCl <sub>2</sub>                 | 0.484 | 10.0               |                                  | 10.0*       | (10)                            | 0.495 | 10.2               |
| Co <sup>2+</sup>             | 5.0         | CoCl <sub>2</sub>                 | 0.486 | 10.0               | Mo(V)                            | 0.001       | 钼酸铵                             | 0.501 | 10.3               |
|                              | 8.0         |                                   | 0.495 | 10.2               | Nb(V)                            | 0.001       | (11)                            | 0.490 | 10.1               |
| Cu <sup>2+</sup>             | 5.0         | CuCl <sub>2</sub>                 | 0.489 | 10.1               | W(V)                             | 0.001       | 钨酸钠                             | 0.495 | 10.2               |
|                              | 7.0         |                                   | 0.498 | 10.3               | F <sup>-</sup>                   | 5.0         | NaF                             | 0.04  | 1.0                |
| Zn <sup>2+</sup>             | 10.0        | ZnCl <sub>2</sub>                 | 0.486 | 10.0               | SO <sub>4</sub> <sup>2-</sup>    | 100         | Na <sub>2</sub> SO <sub>4</sub> | 0.480 | 9.9                |
| Cr <sup>3+</sup>             | 3.0         | CrCl <sub>3</sub>                 | 0.486 | 10.0               | 草酸                               | 100         |                                 | 0.05  | 1.0                |
|                              | 5.0         |                                   | 0.501 | 10.3               | EDTA                             | 10          |                                 | 0.06  | 1.0                |
| Cd <sup>2+</sup>             | 3.0         | CdCl <sub>2</sub>                 | 0.489 | 10.1               | 酒石酸                              | 500         |                                 | 0.483 | 10.0               |
| La <sup>3+</sup>             | 3.0         | La(NO <sub>3</sub> ) <sub>3</sub> | 0.490 | 10.1               | 抗坏血酸                             | 50          |                                 | 0.485 | 10.0               |
| Mn <sup>2+</sup>             | 0.5         | MnCl <sub>2</sub>                 | 0.489 | 10.1               | (9)                              | 100         |                                 | 0.479 | 9.9                |
| Na <sup>+</sup>              | 20.0        | NaCl                              | 0.485 | 10.0               | 柠檬酸                              | 100         |                                 | 0.485 | 10.0               |
| NH <sub>4</sub> <sup>+</sup> | 20.0        | NH <sub>4</sub> Cl                | 0.490 | 10.1               |                                  | 200         |                                 | 0.479 | 9.9                |
| Ni <sup>2+</sup>             | 5.0         | NiSO <sub>4</sub>                 | 0.485 | 10.0               | H <sub>2</sub> O <sub>2</sub> ** |             |                                 | 0.125 | —                  |
|                              | 10.0        |                                   | 0.495 | 10.2               |                                  |             |                                 |       |                    |
| Sr <sup>2+</sup>             | 5.0         | SrCl <sub>2</sub>                 | 0.484 | 10.0               |                                  |             |                                 |       |                    |

\*

\*\*

## Key:

- |                                 |                        |
|---------------------------------|------------------------|
| 1. Interfering substance        | 7. Tartaric acid       |
| 2. Amount added                 | 8. Ascorbic acid       |
| 3. Form of addition             | 9. Citric acid         |
| 4. Absorbance                   | 10. Ammonium molybdate |
| 5. Measured amount of zirconium | 11. Sodium tungstenate |
| 6. Oxalic acid                  |                        |

Table 2. Zirconium Content of Various Alloys

| Sample designation | Original results (%) | Analytical results by this method (%) | Analytical results by SAF [2] or m-NPF method [3] (%) |
|--------------------|----------------------|---------------------------------------|---|
| Aluminum alloy     | 0.1                  | 0.13, 0.13, 0.12                      | 0.14, 0.14, 0.13, 0.14 [3]                            |
| Zirconium bronze 1 | 0.28                 | 0.27, 0.27, 0.28<br>0.27, 0.28, 0.26  | 0.27, 0.27 [2]  |
| Zirconium bronze 2 | 0.21                 | 0.20, 0.22, 0.21<br>0.20, 0.19        | 0.20, 0.21, [2]                                       |

Aluminum alloy and zirconium bronze samples were presented as a gift by Professor Shen Hanxi [3088 0698 3556] of Nankai University. We express our thanks.

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PHYSICAL SCIENCES

RELATIVISTIC QUANTUM CHEMICAL STUDY OF HYDROGEN HALIDE MOLECULES, HALOGEN MOLECULES

Beijing HUAXUE TONGBAO [CHEMISTRY] in Chinese No 11, Nov 86 pp 35-36

[Article by Ma Zhongxin [7456 1813 2450] and Dai Shushan [2071 2885 3790] of the Department of Chemistry, Yuannan University, Kunming; paper received 9 January 1986; corrected copy received 18 March 1986; subsidized by the Chinese Academy of Sciences]

[Text] With increasing atomic number, the relativistic effect on electrons is stronger. With heavy atoms, its value reaches the order of magnitude of coulombic interaction and interatomic bond energy. Therefore, when researching molecular systems containing heavy atoms, relativistic effects must be considered.

This work refers to the methods of Bersuker [1] and Pyykko [2], advances a non-empirical, parametric, relativistic expansion of the Huckel method (REHT), and systematically examines halogen molecules and hydrogen halide molecules.

1. Methods

The single electron Dirac equation is:

$$\hbar\psi = \left[ c\alpha\left(P + \frac{e}{c}A\right) + \beta mc^2 - eV \right]\psi = E\psi \quad (1)$$

In molecular systems, the Dirac-Fock Hamiltonian operator is:

$$H = \sum_i h_i + \sum_{i>j} \frac{e^2}{r_{ij}} \quad (2)$$

Its corresponding wave function,  $\Psi_1(m)$ , has a four step spinor:

$$\Psi_i(m) = \begin{pmatrix} \Psi_i^1(m) \\ \Psi_i^2(m) \\ \Psi_i^3(m) \\ \Psi_i^4(m) \end{pmatrix} \quad (3)$$

with  $\Psi_1(m)$  developed with the atomic ground state  $\Psi_b(m)$  obtaining:

$$\Psi_i(m) = \sum_{b=1}^l c_{bi} \Psi_b(m) \quad (4)$$

The atomic ground state is quantized as  $|1sjm\rangle$ . Its rotational part uses the Slater ground state function to approximate the relativistic radial function. The orbital index is:

$$\xi_i = \left( n + \frac{1}{2} \right) / \langle r \rangle_i \quad (5)$$

The diagonal elements of the Dirac-Fock matrix are the atom's orbital energies calculated relativistic first principles. Off-diagonal elements should be calculated from the Wolfsberg-Helmholtz formula. The overlap integral is calculated according to  $|1sjm\rangle$ . For convenience in comparing research, the EHT parameter adopts results calculated from the Hartree-Fock method. Experimental values are used for molecular bond lengths.

## 2. Results

Pyykko has used similar methods and calculated the electron energy levels of  $I_2$ ,  $Br_2$ , and  $HI$ . In research on the influence of relativistic effects on molecular electronic structure, this work systematically calculates the electronic energy levels, molecular dissociation energies, etc., of diatomic halogen molecules and hydrogen halide molecules. To test the theory, we did the EHT calculations and compared the results with the photoelectron energy spectrum and with pseudo-potential ab initio results. Energy spectrum results are drawn in Figure 1 and Figure 2.

From the figures, it can be seen that, for molecules which do not contain heavy atoms, the difference between considering and not considering relativistic effects is not significant. But as the atomic number increases, the relativistic effects gradually become significant. For example, regarding the  $I_2$  molecule, relativistic contraction leads to a downward shift of the  $\sigma_g$  orbital energy level of 0.2eV, and relativistic rotational-orbital effects split the  $\pi_u$  orbital by 0.77eV. Calculated results agree well with the photoelectron energy spectrum. Conversely, the EHT calculation of halogen molecules only gives three energy levels and for the  $I_2$  and  $Br_2$  molecules the difference between these and the experimental results is too large. Therefore, when researching the energy spectra of systems containing heavy atoms, it is difficult to obtain reliable results without considering relativistic effects.

Table 1 gives the dissociation energy of halogen molecules. It can be seen that REHT gives better results than pseudo-potential ab initio calculations. Analyzing the difference,  $\Delta E_b$ , between  $E_b^{EHT}$  and  $E_b^{REHT}$ , is always greater than zero; also, as the atomic number increases, the difference gets larger. Due to this, it is clear that relativistic effects opposing bonding follow the change in atomic weight and also rise rapidly.

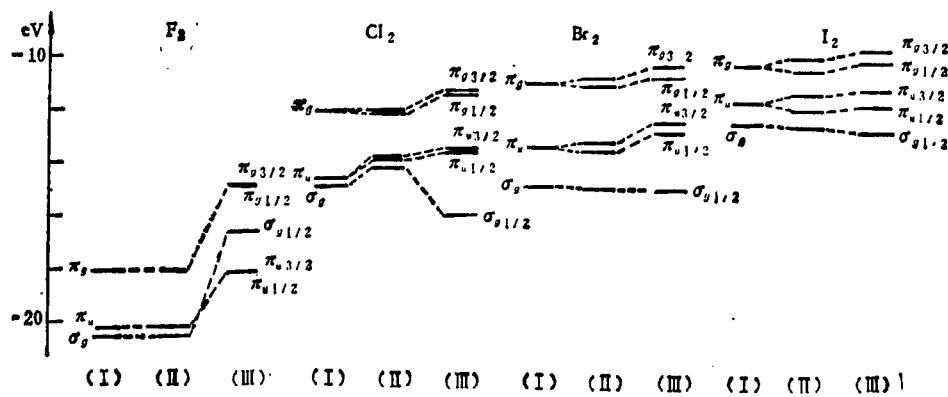


Figure 1. EHT(I), REHT(II) and PES(III) orbital energy levels of halogen molecules

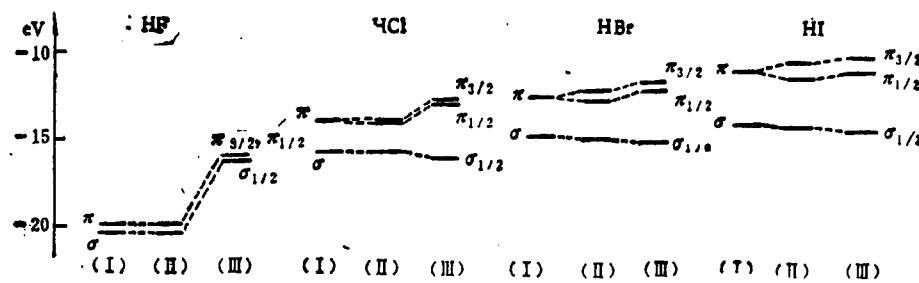


Figure 2. EHT(I), REHT(II) and PES(III) orbital energy levels of hydrogen halide molecules

Table 1. Dissociation Energies (eV) of Halogen Molecules

|                 | $E_b^{\text{EHT}}$ | $E_b^{\text{REHT}}$ | $E_b^{\text{ab}}$ | $E_b^{\text{EXP}}$ | $\Delta E_b^{**}$ |
|-----------------|--------------------|---------------------|-------------------|--------------------|-------------------|
| F <sub>2</sub>  | 1.182              | 1.699               |                   | 1.626              | 0.083             |
| Cl <sub>2</sub> | 1.132              | 1.030               | 1.14              | 2.52               | 0.104             |
| Br <sub>2</sub> | 2.039              | 1.703               | 1.01              | 2.01               | 0.336             |
| I <sub>2</sub>  | 2.406              | 1.776               | 0.871             | 1.58               | 0.630             |

\* ab indicates pseudo-potential ab initio calculation

\*\*  $\Delta E_b = E_b^{\text{EHT}} - E_b^{\text{REHT}}$

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PHYSICAL SCIENCES

SPECTROPHOTOMETRIC STUDY OF MERCURY (II) REACTION WITH  $\alpha,\beta,\gamma,\delta$ -TETRA(4-METHYLAMMONIUMPHENYL) PORPHYRIN

Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 14, No 11, 20 Nov 86 pp 841-843

[Article by Pan Zuting [3382 4371 0080], Xu Mianyi [1776 0517 2034], and Huang Cong [7806 5115] of the Department of Chemistry, Wuhan University; task of the basic science subsidy of the Chinese Academy of Sciences; received 8 June 1985; first paragraph is source-supplied English abstract]

[Text] Abstract: A highly sensitive method for the spectrophotometric determination of Hg(II) with  $\alpha,\beta,\gamma,\delta$  tetrakis-(4-trimethylammoniumphenyl) porphyrin (TAPP) has been developed. Hg(II) reacts quickly with TAPP in the presence of 40% ethyl alcohol at room temperature to form a 1:1 complex at pH 10, and the apparent molar absorptivity of Hg complex is  $2.85 \times 10^5$ . This method is highly selective and free from interference of most other ions after extraction separation. In addition, Mn(II), Zn(II), Co(II),  $S^{2-}$  and  $CN^-$  can be determined via the Hg(II)-TAPP complexation reaction.

Porphyrins are highly sensitive reagents for the spectrophotometric determination of certain metallic ions but the direct color developing reaction of porphyrins and Mercury(II) is, in general, very slow and unstable. Therefore, at present, reports are limited to catalytic, dynamic, and photometric methods. This paper puts forward a new method for the direct spectrophotometric determination of trace amounts of mercury using  $\alpha,\beta,\gamma,\delta$ -tetra(4-Methylammoniumphenyl) porphyrin (abbreviated TAPP). This method is simple to manipulate, does not require heat, and does not require catalytic reagents. The reaction is rapid and stable,  $\epsilon_{449} = 2.85 \times 10^5$ , and its sensitivity is four times greater than the current standard dithizone method. Advantages of this reaction are that it can also determine Mn(II), Zn(II) and Co(II) and indirectly determine  $S^{2-}$ ,  $CN^-$  and others. These will be reported in another paper.

Using ionic extraction effectively raises the selectivity of this method. This method should be used for mercury determination in industrial waste water and other samples and should correspond with results of the currently used standard dithizone method.

## Experimental Section

1. Reagents and instrumentation:  $1.3 \times 10^{-4}$ M aqueous solution of TAPP; 10  $\mu\text{g}/\text{ml}$  Hg(II) standard solution; pH 10.0 sodium borate-sodium hydroxide solution; 0.01 percent (w/v) dithizone solution in toluene.

A model 721 spectrophotometer; a Daojin model 240 ultraviolet spectrophotometer.

2. Experimental methods: Place an appropriate amount of Hg(II) standard solution in a 25 ml flask, add 1.5 ml of TAPP solution, use 0.5M sodium hydroxide to adjust the solution to slightly red, add 5 ml of buffer solution, 10 ml of 95 percent ethanol, and fill to volume with water. Let stand for 5 minutes and measure the absorbance of the reagent in the area of 449 nm with a 1 cm absorbance cell.

## Experimental Results and Discussion

1. Absorption spectrum: From Figure 1 it can be seen that the maximum absorption of TAPP is at 413 nm; Hg(II)-TAPP has a strong absorption peak at 449 nm (another weak absorption peak at 423 nm). This work selects 449 nm as the measurement wavelength.

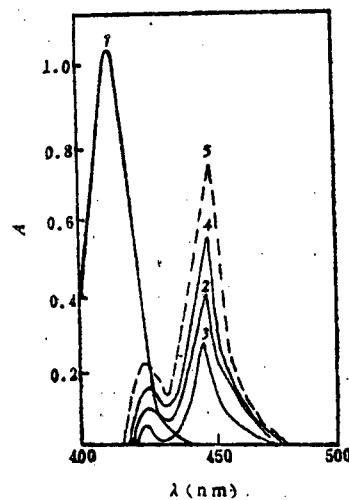


Figure 1. Reagent and coordination complex absorption spectra

- 1 [TAPP] =  $2.6 \times 10^{-6}$ M
- 2 [TAPP] =  $7.8 \times 10^{-6}$ M,  
[Hg<sup>2+</sup>] =  $1.99 \times 10^{-6}$ M
- 3 [TAPP] =  $7.8 \times 10^{-6}$ M,  
[Hg<sup>2+</sup>] =  $1.0 \times 10^{-6}$ M,  
40 percent ethanol media
- 4 [Hg<sup>2+</sup>] =  $1.99 \times 10^{-6}$ M, all else as in 3
- 5 [Hg<sup>2+</sup>] =  $2.99 \times 10^{-6}$ M, all else as in 3

2. Color development temperature and media effects: Experiments show that when the minimum room temperature is 12°C, after 3 hours there is hardly any color development of the Hg(II)-TAPP complex. In a 30°C water bath, total color development takes place after 5 minutes; but after removal, as the temperature decreases, the light absorption declines sharply. However, in a medium of approximately 40 percent ethanol, even at a lower room temperature, total color development can still take place in 5 minutes, the coordination complex is stable for 4 hours, and also the sensitivity is increased by 20 percent. Experimentally it was found that below 12°C, addition of small amounts of silver ion ( $1.85 \times 10^{-6}$  to  $5.56 \times 10^{-6}$ ) can catalyze the color development; there is no research on the mechanism.

3. Other test conditions: Results show that at pH between 9.8 and 11.0 light absorption is permanent. With 1.0-2.5 ml of  $1.3 \times 10^{-4}$ M TAPP and more than 10 ml of 95 percent ethanol, light absorption of the coordination complex reaches its maximum degree of permanence.

4. Determination of the apparent instability constant and the composition ratio of the coordination complex: In a medium of 40 percent ethanol, we use the method of continuous variation and the mole ratio method to find the composition of the coordination complex as compared to Hg(II):TAPP = 1:1. The apparent instability constant,  $K_{in}^1$ , was determined by the continuous variation method and the shifting equilibrium method and they differed giving values of  $1.6 \times 10^{-12}$  and  $2.1 \times 10^{-12}$  for an average of  $1.8 \times 10^{-12}$ .  $K_{in}^1$  in the absence of ethanol is  $6.3 \times 10^{-12}$ . This could be due to a change in the dielectric constant of the solution upon addition of ethanol, which reduces the degree of dissociation of the coordination complex, and also has the effect of increasing the stability and sensitivity of the product.

5. Drawing a working curve. The apparent molar absorption coefficient of the coordination complex,  $\epsilon_{449}$ , is  $2.85 \times 10^5$   $1\cdot mol^{-1}\cdot cm^{-1}$  and Beer's law holds for Hg(II) contents between zero and 20  $\mu g/ml$ .

6. Eliminating the interfering effects of other ions: Experimentally it is shown that over 30 ions have an effect on the determination of mercury. Results are as follows:  $K^+$  (40 mg),  $Na^+$  (60 mg),  $NH_4^+$  (4.5 mg),  $Ca^{2+}$  (0.8 mg),  $Mg^{2+}$  (0.35 mg),  $Ba^{2+}$  (1 mg),  $Al^{3+}$  (0.3 mg),  $Sb^{3+}$  (0.26 mg),  $Cr^{3+}$  (0.2 mg),  $Mn^{2+}$  (0.17 mg),  $Fe^{3+}$  (0.22 mg),  $Fe^{2+}$  (0.35 mg),  $F^-$  (20 mg),  $Cl^-$  (20 mg),  $Br^-$  (25 mg),  $I^-$  (2 mg),  $SCN^-$  (15 mg),  $SO_4^{2-}$  (40 mg),  $NO_3^-$  (100 mg),  $C_2O_4^{2-}$  (9 mg),  $Cit$  (15 mg),  $Tar$  (20 mg),  $Co^{2+}$  (45  $\mu g$ ),  $Ag^+$  (15  $\mu g$ ),  $Ni^{2+}$  (20  $\mu g$ ),  $V(v)$  (90  $\mu g$ ) have no effect on the determination. But the interference from  $Cd^{2+}$ ,  $Pb^{2+}$ ,  $Pd^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ ,  $S^{2-}$ , and  $CN^-$  is severe when they are present in the same quantity as the mercury. Regarding elimination of the interference, consult reference [3], use a solution of dithizone in toluene and separate by extraction; results show that large quantities of  $Cd^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ ,  $Pb^{2+}$ ,  $Pd^{2+}$ ,  $Fe^{3+}$ , etc., ions can be separated by extraction with satisfactory results.

7. Sample analysis: When the mercury content of the sample is extremely low or when coexisting ions exceed allowable limits, then measurement should be done after separation by extraction using a solution of dithizone in toluene.

The method presented here should be used to carry out mercury analysis on industrial waste water samples, etc. Results are shown in Table 1.

Table 1. Results of Analysis for Mercury in Industrial Waste Water Samples

| Sample                       | Added Hg(II)<br>(ppm) | Hg(II) determina-<br>tion via this<br>method (ppm)                 | Hg(II) determina-<br>tion via dithizone<br>method z(ppm)           | Percent<br>recovery |
|------------------------------|-----------------------|--|--|---------------------|
| Industrial<br>waste water #1 | 0                     | 0.50    0.48    0.51<br>0.47    0.50    0.50<br>$(\bar{x} = 0.49)$ | 0.48    0.49    0.52<br>0.51    0.52    0.50<br>$(\bar{x} = 0.50)$ |                     |
| Industrial<br>waste water #2 | 0                     | 5.80    6.20    5.95<br>5.90    6.20    6.00<br>$(\bar{x} = 6.01)$ | 6.24    6.24    5.85<br>5.85    6.20    6.10<br>$(\bar{x} = 6.08)$ |                     |
| Industrial<br>waste water #3 | 0                     | 0.77    0.70    0.77    0.75<br>$(\bar{x} = 0.75)$                 |  |                     |
|                              | 0.50                  | 1.24    1.25    1.27    1.28<br>$(\bar{x} = 1.26)$                 |  | 102                 |
|                              | 1.0                   | 1.70    1.75    1.69    1.70<br>$(\bar{x} = 1.71)$                 |  | 96                  |

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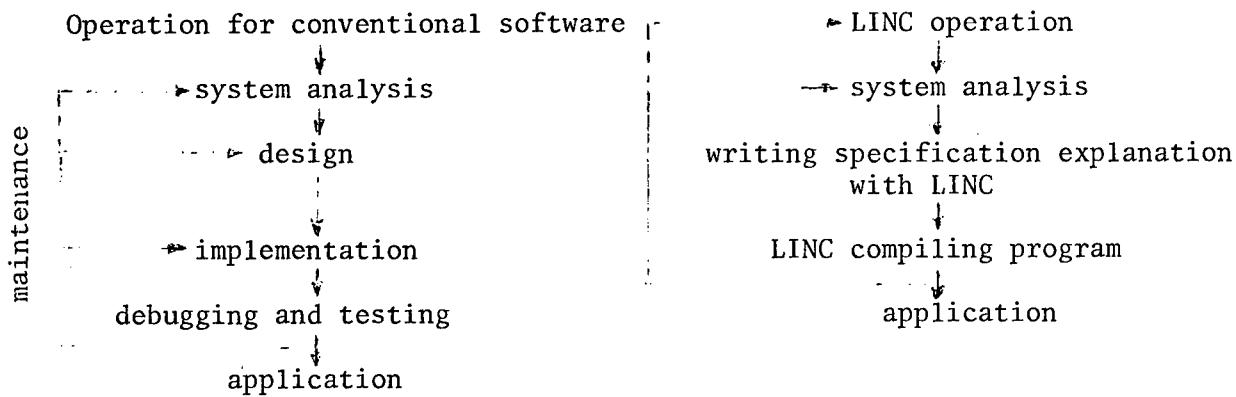
## APPLIED SCIENCES

### LINC SYSTEM FOURTH GENERATION PROGRAMMING LANGUAGE

Beijing JISUANJI YANJIU YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT] in Chinese Vol 23, No 3, 1986 pp 1-4

[Article by Zhong Cuihao [0112 5050 6275], Institute of Software, Chinese Academy of Sciences]

[Abstract] LINC stands for logic and information network compiler, the compiling program of a logic and information network. The LINC system is a logic defining language (LDL), the language used to describe commercial activities executed in a commercial organization for setting up, maintaining and charting commercial data flows. There are different operating modes between a conventional software compiler and LINC, as shown in the following diagram:



Generally, a commercial operation is composed of three parts: components, events and profiles. The component covers various permanent information in commerce, such as products, price lists, employee lists, customer lists, capital and supplier lists. The event term refers to various commercial activities occurring periodically, such as sales, invoices, cash receipts, deposits, withdrawals, and merchandise receipts. The profile is defined as the logic relationship and information transmission network between component and event, dynamically noting and analyzing the commercial activity information, managed and tracked by LINC in the form of sales result and outstanding account with the output in chart form. Thus, the LDL language is very suitable for managing commercial activities. Usually, a system handling a

a commercial program can be designed in days or weeks. The LINC system can automatically form its own operating program, so the system productivity is at least 10 times higher than a third-generation language. Thus, LDL is a fourth generation language, a highly efficient software generation tool.

Currently, China has imported large numbers of computers; however, computer applications have been affected due to an undersupply of programmers, who often are underqualified. Importing the LINC system will promote and enhance computer applications in China. LINC is an advanced software system, pointing to the direction of methods or approaches to pursue the enhancement of software productivity. Studies and development along this direction have not been carried out in China. Borrowing from the achievements of LINC, a fourth-generation language can be studied, thus promoting gains in software techniques. The paper was received for publication in September 1985.

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## APPLIED SCIENCES

### SEARCH, MEMORY METHODS TO FIND SHORTEST PATH

Beijing JISUANJI YANJIU YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT] in Chinese Vol 23, No 3, 1986 pp 15-18

[Article by Wan Fang [5502 2455], Shi Chunyi [4258 4783 0001], and Wang Jiaqin [3769 1367 0617/2953] of Qinghua University]

[Abstract] Computation of the shortest path is among the paramount problems of a transportation dispatching system; a faster way of finding the solution is central. However, methods used previously failed to achieve this purpose. Starting from the framework of the artificial intelligence heuristic search, the paper presents a heuristic algorithm for finding the shortest path on a transportation map. A technique of combining the search method and the memory method is also presented, with the initial analysis completed.

For the minimum mileage ( $\geq 0$ ) corresponding to arc paths on a highway map, a good algorithm currently is the one proposed by E.W. Dijkstra in 1959; however, the computation volume is still quite large. A heuristic algorithm can be worked out by sufficiently utilizing the information (position and direction) provided while referring to a map.

The technique of combining memory and search is easily implemented with a program; however, further exploration is required as to the priority of data processing over the determination method. Moreover, the search efficiency can be enhanced by utilizing memory about other information. Memory about the commonly used routes and the shortest connection between these commonly used routes, and memory about the divisional zones and the shortest connections between the divisional zones can often narrow the search range within local areas.

The search algorithm and memory method presented in the paper have been implemented on PDP-11/23 and Dual-68000 computers with LISP and PASCAL languages. The paper was received for publication in October 1985.

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APPLIED SCIENCES

UTILITY PROGRAM FOR CHINESE-CHARACTER FILES DEVELOPED ON PDP-11 RSX-11M SYSTEM

Beijing JISUANJI YANJIU YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT] in  
Chinese Vol 23, No 3, 1986 pp 19-23

[Article by Lu Shiwen [7627 1102 2429], Institute of Computational Technology,  
Chinese Academy of Sciences]

[Abstract] The Chinese interchange program (CIP) is a software add-on to the RSX-11M operating system, providing users with a designation and index system for Chinese-character files. Although the standard English File-11 is used for software interface in the system, the English file name is transparent. A series of file-service functions resembles a peripheral interchange program (PIP). All that a user sees are Chinese characters.

The main program is written in FORTRAN-77 language, using 24 subroutines written in FORTRAN-77 and MACRO-11 languages with clear modular structure and strict usage relationship. Since a number of MACRO-11 subroutines are nested in FORTRAN-77 subroutines, and the magnetic disk blanketing technique is used, the program is flexible in its functions and has an adequate execution speed with restriction on unlocking internal memory.

CIP software was compiled to meet many PDP-11 users' requirements of Chinese-character terminals in China. The author is grateful to Ma Yinglin [7456 1758 2651] for his advice on software design, debugging and testing; and to Yang Ming [2799 2494] for his assistance in conversion between Chinese and English file names, as well as other activities. The paper was received for publication in October 1985.

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APPLIED SCIENCES

OPTIMIZED COMPRESSION TECHNIQUE FOR LARGE SPARSE MATRICES, APPLICATIONS

Beijing JISUANJI YANJIU YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT] in Chinese Vol 23, No 3, 1986 pp 29-34

[Article by Huang Deyuan [7806 1795 0337], Computer Center of Huanan Engineering College]

[Abstract] This paper presents an ideal method for processing large sparse matrices. In this method, the absolute value of a non-zero location in the search data block indicates the row (or column) number. When the row (or column) is changed, a negative sign appears as the indication. The row (or column) of all zeroes is indicated by "0." Therefore, no addition or subtraction is required in computation when making location search; moreover, the memory required is relatively small. The paper also introduces applications of this technique to addition and subtraction. By using this algorithm, a FORTRAN 77 standard subroutine was compiled; the subroutine has been executed on DPS series computers.

As to the computer computation volume, if multiplication computing technique is used after optimization, the time needed in searching for non-zero locations with multiplication can be further reduced with the advantages of small memory capacity, search convenience, and computer time savings. Two annexes show search programs.

The author is grateful to teachers Deng Zili [6772 5261] and Chen Zhaoping [7115 0340 1627] for their assistance in testing the algorithm for application to subroutines. The paper was received for publication in September 1985.

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APPLIED SCIENCES

AUTOCAD COMPUTER-AIDED DRAFTING SYSTEM

Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 7,  
No 2, Mar 86 pp 13-18

[Article by Song Zhiyong [1345 4249 3938], Zhang Xiaoning [1728 2556 1380],  
and Chen Shi [7115 1395] of Institute of Acoustics, Chinese Academy of  
Sciences]

[Abstract] The AUTOCAD system is a computer-aided drafting system based on a microcomputer; the system was developed by the Autodesk Company (United States). The system can be adapted to many 16-bit microcomputers such as the IBM PC/XT, Vector-9000, and Columbia, to mention just a few. The AUTOCAD system is a universal software package, extensively applied in electronics, construction, machine building, light manufacture, communications and defense. The system provides man-machine interactive communication, with multi-layered menus. With just a slight understanding of English, a user can select commands and parameters from the menu, without any programming, for designing and drafting. Generally, there are 10 major command categories: plotting, display, edit, inquiry, auxiliary plotting, levels and colors, block, footnote, help and menu. Six diagrams show the equipment layout, basic configuration, application routine, menu classification, menu for logic circuit CAD, and GP-IB logic circuit.

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## APPLIED SCIENCES

### SOFTWARE SYSTEM FOR MACHINE TOOLS

Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 7, No 2, Mar 86 pp 54-57

[Article by Wang Xiang [3769 5046], Hangzhou Machine Tools Works]

[Abstract] The machine processing sequence system (MSS) is a computer program regulating the arrangement of production operation for machine tools in a processing factory or shop. The scheme aims at raising productivity of machines and workers for a larger economic benefit. In 1984, two shops of the author's factory used the MSS with a work-hour utilization rate as high as (more than) 90 percent. The key to compiling an operating scheme is the problem of rational permutation when processing  $n$  types of parts through  $m$  machine tools as shown in one of four diagrams in the text; there are  $S$  different ways. If the shop has a large number of machine tools, the value of  $S$  is very large:  $10^{30}$  or more. Such a computation volume requires astronomical time of some trillions of years even using a large main-frame computer capable of 100 million operations per second. The author proposes to use the dynamic ratio and sequence of the production period to optimize the workpieces and machine tools with the three following principles: 1) If several workpieces are waiting simultaneously for a particular machine tool, dynamic ratios are used to select workpieces. Those of smaller dynamic ratios enter into the production sequence. 2) If a single workpiece requires a particular machine tool, the piece enters the production sequence readily without having to compare any dynamic ratios. 3) When several machine tools are waiting for workpieces, those with smaller dynamic ratios enter the production sequence. The dynamic ratio is (the planned production period - the current date - the remaining work hours) divided by the remaining work sequence. If the three above-mentioned approaches are used, computing production sequence is considerably sped up--generally little more than 10 minutes' operation on a microcomputer for a production sequence of hundreds of workpieces passing through several tens of machine tools. The article then goes on to present the program configuration. Three remaining diagrams show the system flowchart, and report forms of production sequences of machine tools and workpieces.

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## APPLIED SCIENCES

### MULTICOMPUTER SYSTEM WITH SHARED MEMORY

Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Vol 5, No 3, May 86 pp 233-236

[Article by Fei Tinghe [6316 1694 0735], Beijing No 3 Computer Plant]

[Abstract] In the shared memory configuration, the main memory of each processor is divided into two independent modules: the main and shared portions. All the shared modules make up one part of the main memory of the control computer, which has, of course, its own main portion of the main memory. Each processor can write the data to be transmitted into its own shared main-memory module. By just shifting the electronic switch from position 1 to position 2, data in the shared memory are transmitted to the control computer. Thus, large amounts of data are transmitted at the instant of switching. The trunk line is divided into several groups so that the system has the functions of multi-command and multi-data flows. The hardware is simple and the system is easily expanded. Operation and transmission can operate simultaneously. This system was developed from MICRONET. The paper only presents the fundamental principles of the multi-computer connection. One table lists the transmission modes of network data. Three diagrams show the fundamental principle, status words, and batch division of the shared system. The paper was received for publication on 1 March 1984.

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## APPLIED SCIENCES

### IMPLEMENTATION OF CHINESE-CHARACTER PROCESSING CAPABILITY WITH ENGLISH-LANGUAGE DATABASES

Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese  
No 6, 6 Jun 86 pp 33-37

[Article by Zheng Yanheng [6774 5888 5899], Luo Zhensheng [5012 2182 5116],  
and Li Jiaying [2621 1367 3841] of Qinghua University]

[Abstract] The SOLAR computer system imported into China from France has an operating system serving multiple-user transactions; the core of the operating system is a network database system, using a Televideo 950 Western-language system. Based on the Chinese-made ZD-2000 Chinese-character terminal, the authors designed a software package that is compatible with the Televideo 950 terminal; thus, the SOLAR computer database can process Chinese characters. This paper is divided into three parts: 1) problems in designing a Chinese terminal compatible with the Western language terminals; 2) compatibility between the Televideo 950 terminal and the Chinese-made ZD-2000 Chinese-character terminal; and 3) conclusions.

The areas discussed in the paper include: how to realize Chinese-character functions in interactive dialog applications; the database functions are detailed. Two functions should be provided for interactive dialog with the database system: 1) Data are collected efficiently and then processed. 2) Examine, update and maintain the database. To perform these two functions, generally a data instruction language and a data descriptive language are provided to users via a database. In the MUX system of the SOLAR computer, in contrast, the INTGEN language and the MCS system are provided to perform these functions.

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APPLIED SCIENCES

IMPLEMENTATION OF CCDOS IN CROMENCO MICROCOMPUTER

Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese  
No 6, 6 Jun 86 pp 38-40, 48

[Article by Dong Liang [5516 0081] of Logistics Department, Xinjiang Military Region]

[Abstract] This paper proposes a new method for the Western-language system of the Cromenco microcomputer. Under this method, the corresponding parts of the operating system in internal memory are revised with a program to which a Chinese-character processing function has been added without modifying the operating system of the principal magnetic disk. Thus, re-development can be avoided when updating versions of the Western-language operating system. Moreover, a reverse direction modification can be very easily accomplished when leaving the Chinese-character system. Chinese-character processing modules are added onto the sublayer of the operating system at the interface with the base machine to furnish input/output capability with Chinese characters. Since it is more difficult to analyze and modify the operating system in China, at present analysis and modification are generally conducted on a single version of the Western-language operating system to produce the corresponding version of the Chinese-character operating system, such as any one of the various CCDOS [Chinese Character Document-Operating System] developed on PC XT's in China, and the EC-DOS by the Jiangsu Provincial Computational Institute.

The Cromenco CCDOS was successfully developed in October 1984; after a half-year's trial run, technical certification was granted in April 1985. The system has the following features: 1) 64 K internal memory for a single user; 2) multiple internal memory board (64 K) multi-user system for selective addressing, capable of executing MULTI-USER BASIC or the CROMIX operating system; 3) two CPU (Z80 and 68000) dual processing board and addressable internal memory board greater than 256 K; 4) PRI board or TU-ART board used as the interface boards for the printer; and 5) excess internal memory space in addition to 64 K internal memory required for executing CCDOS. Two diagrams show a principal flowchart of the CCDOS and the internal memory distribution of CCDOS.

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APPLIED SCIENCES

BIOLOGICAL EFFECT OF ULTRASOUND, DIAGNOSTIC SAFETY

Beijing YINGYONG SHENGXUE [APPLIED ACOUSTICS] in Chinese Vol 6, No 1, Jan 87  
pp 1-6

[Article by Feng Ruo [7458 5387], Institute of Acoustics, Nanjing University]

[Abstract] Generally speaking, whether clinical diagnostic ultrasound is safe or not can be determined by finding out if the use dosage induces a particular biological effect. In other words, this involves finding the minimum ultrasonic dosage that can induce the biological effect; this minimum dosage is also called the threshold dosage. This paper evaluates the views authoritative in the 1980's on the published safe threshold dosage, as well as the current status and problems needing urgent study. Proper attitudes in the ultrasonic clinical diagnosis and some guiding principles are given. Five figures show variations in sound pressure squared with time in pulse waves, the ultrasonic threshold dosage curve of mammals, and the threshold dosage curve causing tissue damage with focused ultrasound, application dosage ranges of pulse echo ultrasonic and Doppler diagnostic instruments, and the relationship between red corpuscles suspensoid of gas microbubbles, ATP release, and the sound intensity of pulse ultrasonic irradiation. The paper was received for publication on 24 March 1986.

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APPLIED SCIENCES

PB-1 TYPE NARROW PULSE PIEZOELECTRIC POLYMER REVERSIBLE TRANSDUCER

Beijing YINGYONG SHENGXUE [APPLIED ACOUSTICS] in Chinese Vol 6, No 1, Jan 87  
pp 25-31

[Article by Yuan Yiquan [5913 2496 0356] and Shao Yaomei [6730 5069 2734] of Nanjing Engineering College, and Shi Bingwen [2514 3521 2429] of Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences]

[Abstract] The authors successfully developed a PB-1 type PVDF (polyvinylidene fluoride) reversible piezoelectric transducer with a wide passband. Its center frequency is 500 to 900 KHz; the passband Q is 1.5; the transmitting voltage response (level) is 148.9 dB (re: 1 $\mu$ Pa/V); and its sensitivity is -210 dB (re: 1V/ $\mu$ Pa). In water, the sound pulse persistence time is 7 to 10  $\mu$ s with sufficient sound power output. The electroacoustic efficiency is about 10 percent.

This paper presents the structure, theoretical analysis, measurement results, and application effect of the transducer, proving that theory is consistent with experiments. The paper can serve as a reference in designing electro-acoustic, sonar, ultrasonic and other PVDF transducers. The structure of PB-1 type transducer is shown in the following diagram.

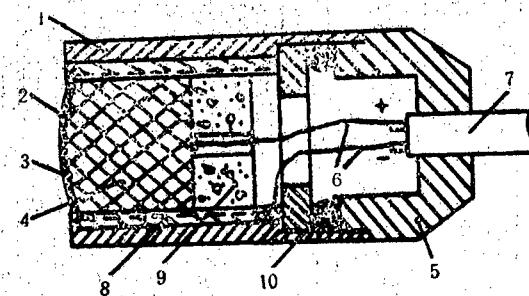


Figure 1

1. Metal shell;
2. Sound-transmitting protective layer;
3. Multi-overlapping layer PVDF piezoelectric thin film;
4. Spherical crown curved surface high impedance hard lining;
5. Rear end metal shell;
6. Electrode lead wire;
7. Terminal cable;
8. Insulation frame;
9. Second absorbing back lining;
10. O-shaped rubber band.

The other 10 diagrams show a photograph of the transducer, a Mason equivalent diagram of a hard-back lining PVDF transmitting transducer, the principle of the PVDF multi-overlapping layer transmitter, a spherical crown radiator, a process of instantaneous response and strain wave, sonar curves, the relationship between number of overlapping layers and input impedance, transmitting and receiving frequency responses, directivity, and sounding record of a paraffin board. Five tables list comparative data on characteristics of a PVDF piezoelectric thin film in China and abroad, interchangeability properties and frequency response values, and measurement indexes. The paper was received for publication on 19 November 1985.

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APPLIED SCIENCES

LASER BEAM CORRECTION, TV TARGET DISPLAY TECHNIQUE

Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 6, No 5, Aug 86  
pp 229, 228

[Article by Lei Shuchun [7191 2579 2504] and Zhang Zichun [1728 1311 4783]  
of Chengdu Thermometer Factory]

[Abstract] For a light firearm, its firing accuracy is an important index in evaluating its performance. For a long time, the traditional test shooters manually conducted target practice to evaluate the accuracy of a firearm. This way is not objective, wasting both time and bullets. In solving these problems, the authors developed a laser aiming system. A helium-neon laser is used as the light source of firearm calibration; the output is visible red light. An industrial television set displays the target. Its operation principle is shown in the following diagram.

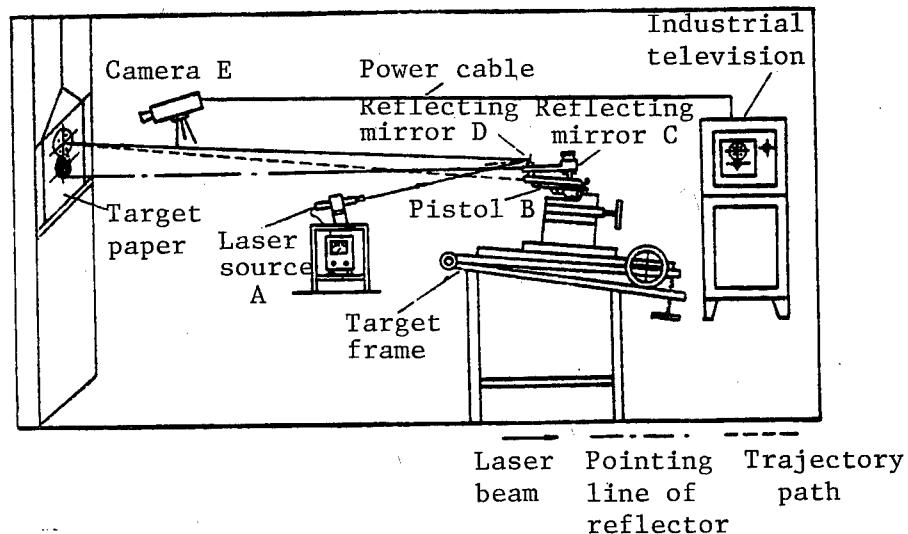


Figure 1

A table lists data on manual sighting and laser beam correction for firearms.  
The paper was received for publication on 4 March 1986.

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## APPLIED SCIENCES

### OBLIQUE OPTICAL AXIS SPECKLE PHOTOGRAPHY USED FOR MEASURING THREE DIMENSIONAL DISPLACEMENTS OF PRACTICAL ENGINEERING STRUCTURES

Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 6, No 5, Aug 86  
pp 193-197

[Article by He Yuming [0149 3768 2494], Tan Yushan [6223 3768 1472], and Gu Chongxian [7357 1504 6902] of Laser and Infrared Laboratory, Department of Mechanical Engineering, Xian Jiaotong University]

[Abstract] The paper introduces a new technique for measuring the three dimensional displacements using oblique optical axis speckle photography (OSP). The accuracy of measuring out-of-plane displacements can be improved, and the visual field of the photographic lens can be utilized when the OSP method is used. The experimental results of 3-dimensional deformation of both the sample and the machine tool headstock are illustrated. Moreover, the Apple II microcomputer image processing system for automatic analysis of the Young's fringe patterns is described in principle. Ten diagrams show the photographic analysis with an oblique optical axis, geometric relationship of object and image, comparison between oblique and normal optical axes, Young's streaks, 3-dimensional displacement test, experimental and theoretical curves of displacement of a cantilever beam, thermal deformation of the headstock of model CMO 620 lathe, image processing system, four scanning directions, and three photographs showing peak values of streaks.

The authors are grateful to Cai Yuanlong [5591 0337 7893], Yan Hanbing [0917 1383 0393] and Guo Xingguo [6753 5281 0948] for providing microcomputer interfaces; and to Zhao Hong [6392 1347], Wang Ziwu [3076 1311 0582], Wang Jianmin [3076 1696 3046] and Wang Xizhou [3769 0823 3166] for their cooperation. The paper was read at the 1986 ICHA. The text was received for publication on 25 June 1986.

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CSO: 4009/17

APPLIED SCIENCES

APPLICATION OF HOLOGRAPHIC LENS IN HEADS-UP DISPLAY

Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 6, No 5, Aug 86  
pp 223-228

[Article by Chen Huangming [7115 2515 2494] and Lu Bo [4845 3134] of Department of Optical Engineering, Beijing Institute of Technology]

[Abstract] The holographic heads-up display is an advanced observation aiming instrument used in modern aircraft, especially fighter planes. The display furnishes a wealth of flight data to the pilot, thus relieving his observation fatigue and enhancing the aircraft's combat capability. The article is a detailed study on properties of the holographic lens. Both the principle and layout of designing holographic heads-up display are presented; a series of examples are given. Twelve figures show the imaging principle, analysis of focal plane, focal-plane distributions of coaxial and out-of-axis holographic lens, determination of ideal image plane, recorded and observed optical path, distributions of image points and aberration on the axis, determination of object and image space optical axis, optical system of the holographic heads-up display, and aberration curve. Two tables list distribution data of the image plane, and the relationship between two angles in the image plane. The article was read at the 1986 ICHA; it was received for publication on 29 May 1986.

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## APPLIED SCIENCES

### CHARGE COUPLED DEVICES

Beijing WULI [PHYSICS] in Chinese Vol 15, No 9, Sep 86 pp 548-550, 526

[Article by Luo Tianxiang [1482 1131 4161], Institute of Physics, Chinese Academy of Sciences]

[Abstract] The charge coupled devices (CCD) is a new semiconductor surface-effect device, developed in the early 1970's and based on the metal-oxide-semiconductor (MOS) technique. When appropriate sequence clock pulses are applied on a device, the surface charge packets move in a controlled fashion along the semiconductor surface. By utilizing this fundamental principle, CCD's with different properties may be manufactured, such as for image sensing, information transmission and processing, and data storage. CCD is a promising random access memory (RAM) with large storage capacity, as well as faster write/read time than magnetic disks. Eight diagrams show the principle of MOS capacitor storage of charges, potential gradient of signal charge; and principles of three-phase CCD, two-phase clock CCD, CCD camera, and linear array CCD facsimile apparatus; CCD simulation delay line, CCD digital filter, and CCD correlator.

### IMAGE TUBES

Beijing WULI [PHYSICS] in Chinese Vol 15, No 9, Sep 86 pp 553-556

[Article by Tian Jinsheng [3944 6855 3932], Yunnan Optical Instruments Plant]

[Abstract] Image tube is the general term for image converter tubes and image enhancer tubes. First-generation image tubes mainly gain their enhancement with a cascade of individual image tubes. Second-generation image tubes gain enhancement by doubling photoelectrons in using a micro-channel board. Third-generation image tubes gain enhancement with an electron affinity potential, photoelectric cathode of high quantum efficiency, as well as with a micro-channel board. Since these image tubes have very high gain (greater than  $10^4$ ), the tubes can be used at very weak illumination levels of  $10^{-3}$  to  $10^{-4}$  lux; therefore, the first-, second- and third-generation image tubes are also called glimmer tubes. China can manufacture only first- and second-generation image tubes. A table lists specifications and parameters of image tubes made by the Yunnan Optical Instruments Plant. Another table lists parameters of the third-generation image tubes which are available only from major companies in the United States, Britain, and France, since this is early-1980's technology. Two figures show the schematic layout of an image tube, and schematics of some first- and second-generation image tubes.

CLUSTER ION BEAM DEPOSITION TECHNOLOGY

Beijing WULI [PHYSICS] in Chinese Vol 15, No 9, Sep 86 pp 532-534

[Article by Guo Huacong [6753 5478 5115], Institute of Nuclear Science and Technology, Sichuan University]

[Abstract] In 1972, T. Takagi et al. of the Electronics Department, Kyoto University (Japan) proposed a new deposition technique, called the cluster ion beam deposition technique. The technique has several advantages: fast deposition rate (from tens of nm to  $\mu\text{m}/\text{min}$ ), deposition density approaching to the density of the background block, high adhesion between deposition and base, controllable property of the deposited material, formation of monocrystal film, amorphous film, metal film, insulator film, compound film, and high polymer film onto a base at a relatively low temperature. A cluster beam deposition device was successfully built by the Institute of Semiconductors (Chinese Academy of Sciences) depositing a germanium monocrystal film onto a silicon base. The following diagram shows the schematic structure of cluster ion beam source.

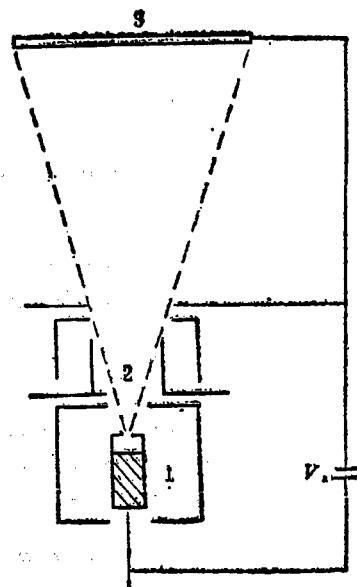


Figure 1  
1. Emitting zone; 2. Ionization zone; 3. Base

This kind of deposition technique is still undergoing improvement; a unique patent was applied for by the Mitsubishi Electric Corporation (Japan) for the formation of monocrystalline Si film onto a base by ionization and dissolving of SiH<sub>4</sub>, which is sputtered at room temperature.

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APPLIED SCIENCES

SIMPLIFIED MONTE CARLO SIMULATION OF BEIJING SPECTROMETER

Beijing GAONENG WULI YU HE WULI [PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS]  
in Chinese Vol 10, No 4, Jul 86 pp 385-392

[Article by Wang Taijie [3769 3141 2638], Wang Shuqin [3769 3219 3830], Yan  
Wuguang [0917 2976 0342], Huang Yinzhi [7806 0936 2535], Huang Deqiang [7806  
1795 1730], and Lang Pengfei [6745 7720 7378] of the Chinese Academy of  
Sciences Institute of High Energy Physics; paper received 15 February 1985;  
first paragraph is source-supplied abstract]

[Text] Abstract: A Monte Carlo simulation program called BESMC was completed using a Monte Carlo method to functionalize instrumental properties and simulate measured values directly by smearing high energy particle kinematic quantities. This simulation can be used to study the multiplicity, particle types, and the distribution of the four momentums of the final state of positron-electron collisions as well as to investigate the reaction of the Beijing spectrometer to these final states. The simulation provides means to demonstrate the rationality of the Beijing spectrometer and to discuss the selection of physics projects for the Beijing spectrometer.

I. Introduction

The Beijing spectrometer (BES)[1] (Figure 1) in planning for the Beijing positron-electron collider is composed of drift chamber, flight time counter, shower counters and mu particle counter as well as a solenoid magnet and other subsystems, geometrically forming cylinders in symmetry. (In the discussions below the direction of the beam is taken as the coordinate axis.)

The Monte Carlo program, BESMC, for simulating the BES, directed toward the needs of the planning stage, can evaluate the following questions:

- A. The possibility of selected physics project;
- B. Taking the achievement of physics goals as the standard to evaluate different sub-plans in certain subsystems;
- C. Taking the achievement of physics goals as the standard to evaluate the rationality of each subsystem's indices.

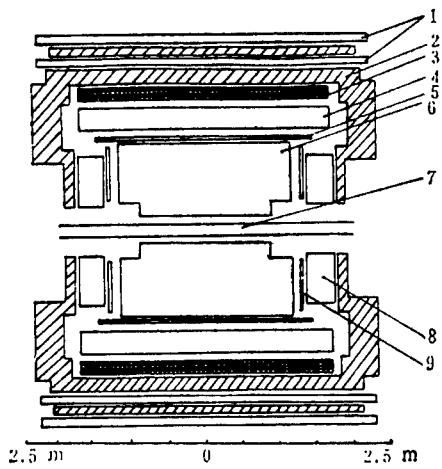


Figure 1. BES Design Schematic

- |                        |                                |
|------------------------|--------------------------------|
| 1. $\mu$ counter       | 6. Drift chamber               |
| 2. Impedance iron      | 7. Beam tube                   |
| 3. Coil                | 8. End cap shower counter      |
| 4. Shower counter      | 9. End cap flight time counter |
| 5. Flight time counter |                                |

## II. The Simplified Monte Carlo Simulation Method for High Energy Physics Experiments

BESMC adopts a simplified method for simulating a high energy physics experiment, the general flow of which is given in Figure 2 with the following major steps:

1. Simulation of the physical processes of the mutual effects of high energy particles. Based on a physical model (section III), Monte Carlo sampling is used to produce a description of a final state quantity, the multiplicity number  $N$ , particle type  $ID_i$ , and the kinematic quantity  $K_i$  ( $i = 1, \dots, N$ ).
2. Simulation of motion of the final state particles in the detector with the following principle points:
  - a. Calculation of the coordinates at various points on the particles' motion path, considering deflections in the magnetic field with regard to charged particles.
  - b. For short lived particles, using index distribution sampling [9] to randomly determine the flight distance before decay, the decay point is processed into a new vertex. Discrete type distribution sampling [9] is used to randomly determine the decay path. The four momentums of the decay products, aside from specific conditions, are all produced by the method of passing through homogeneous phase space distribution to make a random sampling. [3]

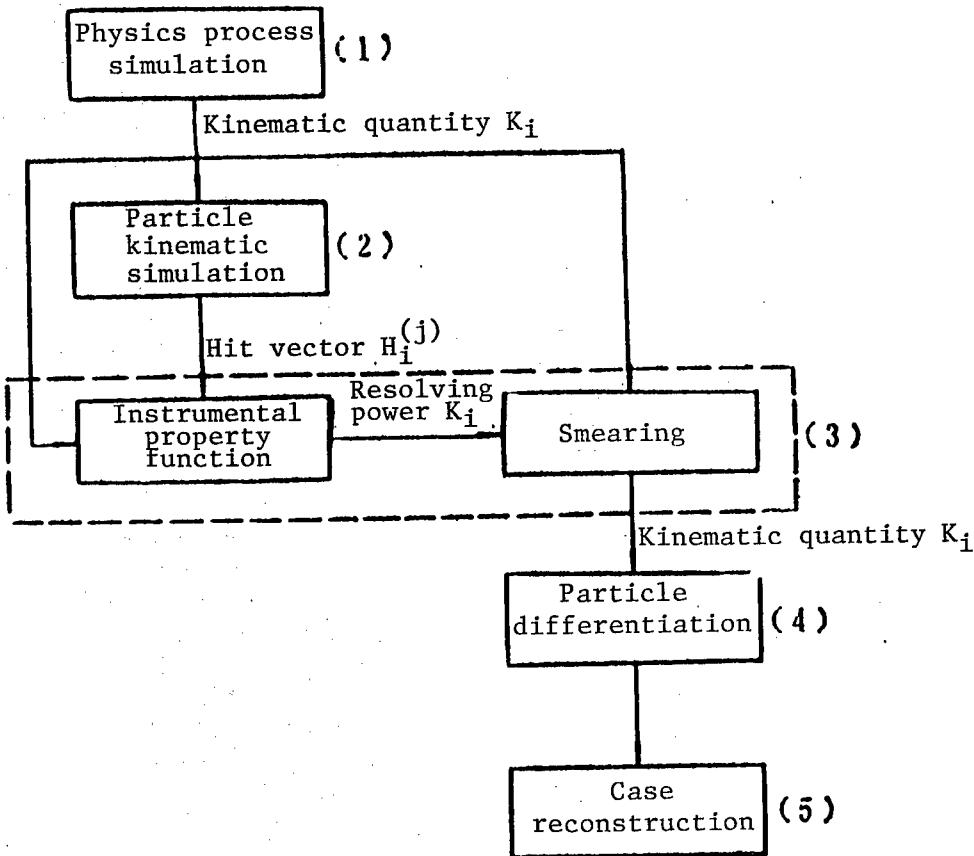


Figure 2. Schematic of Simplified Monte Carlo Simulation Method in BESMC

- c. Because BESMC does a simplification of the process with regard to magnetic showers, for  $e$  and  $\gamma$  particles which can produce showers, their motion paths are calculated according to long lived particles.
- d. Based on the geometrical position of the particle track and the detector, interpolation methods<sup>[4]</sup> are used to calculate the intersection of the particle with the detector, describing the vector of the intersection of the  $i$ th particle with the  $j$ th detector (section IV) as hit  $H_i^{(j)}$ .
- 3. Functionalize the properties of the detector and smear the kinematic quantities of the particles.

When particles produce a hit on a certain detector the action of the detector is abstracted to make certain kinematic quantities of the particle deflect from an initial value  $K_i$ , becoming a "measured value"  $K'_i$ . This process is called smearing.

The degree of smearing is just the resolving power of the particular detector to measure the particular particle. It is determined by the special characteristic  $I^{(j)}$  of the detector itself, the kinematic quantity  $K_i$  of the incident particle, and the hit  $H_i^{(j)}$ . If the resolving power of the  $j$ th detector to measure the  $i$ th particle is written as  $R_i^{(j)}$ , then

$$\mathbf{R}_i^{(j)} = F(\mathbf{I}^{(j)}, \mathbf{K}_i, \mathbf{H}_i^{(j)}) \quad (2.1)$$

One can consider the measured value of the particle kinematic quantity  $K'_i$  subordinate with  $K_i$  as the expectation value. Taking  $R_i^{(j)}$  as the normal distribution of the standard deviation, then the method of using normal distribution random sampling can produce  $K'_i$ . [2]

It is precisely this step, functionalizing the detector and smearing the particle kinematic quantities, which avoids detailed simulation of the behavior of particles inside the detector and reliance on off-line analysis case reconstruction making simplified simulation practical.

4. Simulation of particle discrimination. Based on the simulated measured value  $K'_i$ , distinguish the particle type  $ID_i$ .

5. Simulation of case reconstruction. Based on the simulation measured value  $K'_i$  and  $ID_i$ , reconstruct certain short lived particles or reconstruct the entire properties of cases.

### III. Simulation of the Physical Processes for Electron-Positron Collision

The types of models describing an  $e^+e^-$  collision already in BESMC include the following:

#### A. The Field-Feynman meson dual jet model. [5]

Taking a non-resonant state dual jet production[6] they describe a process where  $e^+e^-$  pass through a single photon annihilation producing a positive anti pair of quarks. Then according to the fragmentation function distributed momentum, a hadron becomes dual jets.

BESMC takes the quantities to control this fragmentation process as input parameters.

#### B. Production and decay model of a D meson pair.

A D meson pair is produced from  $\psi''$  (3770) decay with angular distribution

$$\frac{d\sigma}{dQ} \propto 1 - \cos^2\theta \quad (3.1)$$

$\psi''$  decays to  $D^0\bar{D}^0$  or  $D^+\bar{D}^-$  according to a given probability. In the D meson decay modes included in BESMC we considered up to first order (yadi) processes allowed by Cabibbo and considered only  $c \rightarrow d$  flow in (yadi) processes. The branching ratio of the various decay paths served as input parameters. Aside from semileptonic three dimensional decay, the final state four momentums of the various decays are obtained using homogeneous phase space random sampling.[3]

C. Production of  $\tau$  heavy lepton pairs.

For the angular distribution of  $\tau$  heavy lepton pairs,[20] decay modes and branch ratios of  $\tau$  heavy leptons we use results of reference [7]. Branching of  $\tau$  decay to continuous spectra can be reduced to ( $v4\pi$ ).

D. Decay models of short lived particles.

In the various models above, the short lived particles produced decay according to the major decay paths and branch ratios laid out in particle data tables.[8] In BESMC decay processing includes  $\mu$ ,  $\pi$ ,  $K^\pm$ ,  $K_S^0$ ,  $\Lambda$ ,  $\eta$ ,  $\rho$ ,  $\omega$ ,  $\phi$ ,  $K^*$ ,  $A_1$  and  $\eta'$  particles.

IV. Calculation of Motion Tracks and Hit Vectors

BESMC by a solenoid magnetic field nearly makes a homogeneous axial magnetic field in which charged particle tracks are helical and those of neutral particle are straight.

The external interface of drift chamber, flight time counter, shower counter,  $\mu$  counter and other physical detectors are considered to be "virtual detectors" and a number of "virtual detectors" of the same type compose a "virtual detector set." The "virtual detectors" in one set can use the same mathematical processing.

The BES is composed of 9 "virtual detector sets," including 23 "virtual detectors." Their names and meanings are seen in Table 1.

Table 1. "Virtual Detector Sets" Composing BES

| <u>Sequence<br/>number</u> | <u>Name</u> | <u>Meaning</u>  | <u>Geometry</u>           | <u>Number of<br/>detectors</u> |
|----------------------------|-------------|---|---------------------------|--------------------------------|
| 1                          | DRIF        | Inner and outer cylindrical surface of the inside and outside drift chamber | Whole cylindrical surface | 4                              |
| 2                          | DRFE        | End surface of the inside and outside drift chamber                         | Ring surface              | 4                              |
| 3                          | TOFB        | Barrel part flight time counter   | Whole cylindrical surface | 1                              |
| 4                          | TOFE        | End caps flight time counter  | Ring surface              | 2                              |
| 5                          | SHWR        | Inner and outer cylindrical surface of the barrel part shower counter       | Right cylindrical surface | 2                              |
| 6                          | SHWE        | End surface of the barrel part shower counter                               | Ring surface              | 2                              |

| <u>Sequence number</u> | <u>Name</u> | <u>Meaning</u>                               | <u>Geometry</u>            | <u>Number of detectors</u> |
|------------------------|-------------|--|----------------------------|----------------------------|
| 7                      | EDCP        | Plain surface of the end caps shower counter | Ring surface               | 4                          |
| 8                      | EDCY        | Side surface of the end caps shower counter  | Broken cylindrical surface | 2                          |
| 9                      | MUON        | $\mu$ counter                                | Whole cylindrical surface  | 2                          |

One by one it tests whether or not every particle track has intersected with each "virtual detector." Particles which have not intersected with any "virtual detector" are considered to have flown into the BES sensor zone. For each intersection there it calculates the hit vector  $H_i^{(j)}$ .

$H_i^{(j)}(1)$ : x coordinate (for plain "virtual detectors") or  $\varphi$  coordinate (for cylindrical "virtual detectors");

$H_i^{(j)}(2)$ : y coordinate (plain) or z coordinate (cylindrical);

$H_i^{(j)}(3)$ : length of spur from mutual function vertex to intersection;

$H_i^{(j)}(4)$ : flight time from collision point to said intersection;

$H_i^{(j)}(5)$ : directional tangent  $dx/dz$  (plain) or  $d\varphi/dr$  (cylindrical) of particle motion at hit point;

$H_i^{(j)}(6)$ : directional tangent  $dy/dz$  (plain) or  $dz/dr$  (cylindrical) of particle motion at hit point.

## V. Functionalization of the Detector Properties

### A. Make momentum and directional measurement of changed particles in the drift chamber.

Deviation in momentum and directional measurement of changed particles in the drift chamber arises from two sources: Positional measurement accuracy and multiple Coulomb scattering. The standard deviation of measured values of momentum and angle is related to the coefficient particles hitting the drift chamber and the material thickness of penetration as well as other factors of spacial resolution ratio of the drift chamber and the strength of the magnetic field in the chamber. For formulae of the functional relations to calculate the standard deviation see [10] and [11].

### B. Make measurement of the ionization energy loss of changed particles in the drift chamber.

Ionization energy loss measured in the BES drift chamber is used together with the measured value of momentum to make charged hadron discrimination, serving as a supplementary means to flight time measurement to differentiate particles.

Since the ionization energy loss displays the Landau distribution, generally for ionization energy loss measurements we seek the Truncated Mean.[12] BESMC directly does a sampling of the truncated mean of multiple ionization energy losses, first determining the most probable ionization energy loss  $E_{mp}$ [12] of a particle passing through one layer of a gas sample layer, the truncated mean of N layer gas sample displays a normal distribution with  $E_{mp}$  as the expected value and standard deviation is[12]:

$$\sigma_{tm} = 0.407N^{-0.46}(tp)^{-0.32} \quad (5.1)$$

in which t is the sample layer thickness and p is the gas pressure.

### C. Measurement of flight time.

In the calculation of the hit vector (section IV), the flight time arrived at for the particle to reach the flight time counter is the expected value of its measured value distribution and the standard deviation adopts the design index of the resolution ratio of the BES flight time counter.

### D. Making measurements of the energy and direction of e or $\gamma$ particles in the shower counter.

The BES shower counter is an electro-magnetic sampling energy measuring device with lead as the absorbing body. Its resolution ratio for energy measurement and direction measurement is related to the incident particle energy, length of the particle track in the counter, and design parameters of the counter (thickness of the absorbing body, sensitivity zone components, etc.).[13,14]

## VI. Simulation of Particle Discrimination

The differentiation of the BESMC with respect to photons, electrons, muons, and hadrons is absolute. That is, there is no discrimination error. Discrimination of charged hadrons uses momentum measurement plus flight time measurement or momentum measurement plus ionization energy loss measurement.

The discrimination method using momentum and flight time is as follows.[10] We use the measured momentum  $P_m$ , measured flight time  $t_m$ , and distance flown s of the charged hadron. Three possibilities present themselves: the particle is  $\pi$ , K, or P. (Using i =  $\pi, K, P$  as indication) for possibility i, the particle mass is  $m_i$  and the predicted flight time is

$$(t_e)_i = \frac{s}{\beta_i C}, \quad i = \pi, K, P \quad (6.1)$$

where  $\beta_i$  is the particle speed for the ith possibility. Under possibility i we get the probability for measured values  $t_m$  to be

$$(P'_{TOF})_i = \frac{1}{\sqrt{2\pi}\sigma_{TOF}} \exp \left[ -\frac{1}{2} \left( \frac{t_m - (t_e)_i}{\sigma_{TOF}} \right)^2 \right] \quad (6.2)$$

and normalizing the probability for the three possibilities,

$$(P'_{TOF})_i = \frac{(P'_{TOF})_i}{\sum_{j=\pi, K, P} (P'_{TOF})_j}, \quad i = \pi, K, P \quad (6.3)$$

The criterion for accepting possibility  $i$  are:

- 1) Said  $i$  corresponds to the largest  $(P'_{TOF})_i$ ;
- 2)  $(P'_{TOF})_i > 0.5$ .

The method for hadron discrimination using momentum and ionization energy loss is similar to the above method.

## VII. Simulation of Case Reconstruction

BESMC can reconstruct a number of short lived particles by these means: First selecting a fixed particle combination the effective mass is calculated based on simulated measured values (section II) and particle types (section VI). If the calculated results fall inside a fixed range then a short lived particle is considered to have been reconstructed.

BESMC reconstructed particles are:  $\pi^0$  picking a pair of  $\gamma$ ;  $K^0$  picking a pair of oppositely charged  $\pi$ ; D mesons picking a K and some  $\pi$ , if the sum of the charges is 0 or  $\pm 1$ . (Altogether processing 35 hadron decay paths reconstructs a D.)

## VIII. Program Structure

BESMC is written in FORTRAN-77 and includes a portion exclusively to simulate the BES and some supportive general programs, the interrelationships of which are seen in Figure 3. In the very center of the figure is the general library program provided by CERN[18] inside which there is the histogram program package HBOOK[15], the program package ZBOOK[16] for dynamic management of internal storage, the program package FFREAD[17] for free form input, and a number of subroutines for specific calculations. For revision and management of the BESMC source program we used CERN's source program management software PATCHY.[19]

BESMC uses CERN's physics experiment simulator program GEANT[4] as its framework. GEANT provides a number of user subroutine names and determines their function and form, serving to link as an interface between the user and GEANT (the next layer from the center in Figure 3). Apart from serving as framework, GEANT also completes the tracks of particle motions and calculates the hit vectors.

The general program flow of GEANT is shown in Figure 4. Its initialization is completed by GINIT and the initialization work carried out by BESMC is input of various data, definition of the media of the various parts completing the BES, definition of the various particles, definition of the "virtual detectors," and their integration.

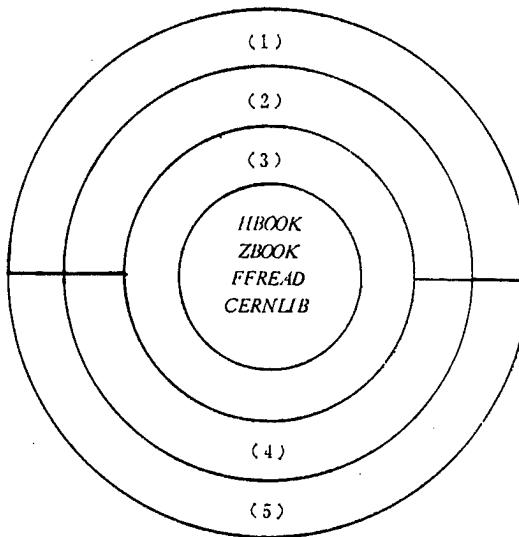


Figure 3. Interrelations Between the Various Component Parts of BESMC

- |                   |  |
|-------------------|--|
| 1. Physical model | 4. User subroutines                    |
| 2. GEANT          | 5. Detector property functionalization |
| 3. GEANT          | and kinematic quantity smearing        |

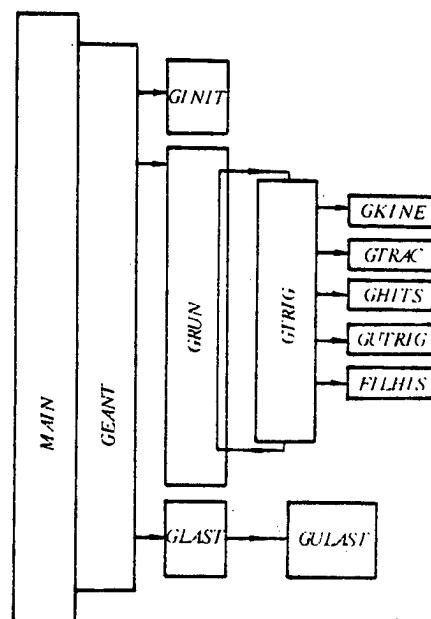


Figure 4. General Program Flow GEANT in BESMC

The main body of GEANT is GRUN in which each call to GTRIG completes a simulation for one case. The simulation of each case is divided into three steps: production of the kinematic quantities (GKINE), calculation of the particle tracks (GTRAK), and the calculation of the hit vectors (GHITS). After GTRIG completes these three steps it provides GUTRIG to allow the user to engage in processing of the simulated results of a case. In GUTRIG, BESMC completes the work outlined in sections II.3 to II.5.

As BESMC completes the subroutine GULAST, the statistical results for the simulated case are output.

BESMC has already been applied to simulate the behavior of BES under various physical models. Under the D meson model, using the BES design parameters we obtained a reconstruction rate of 51 percent for  $\pi^0$  mesons, charged  $\pi$  mesons were correctly differentiated at a rate of 92 percent, and charged K mesons were correctly distinguished at a rate of 89 percent. A complete appraisal of the BES capabilities under different models will be recounted in a separate paper.

This work was done to satisfy a request by Ye Minghan to complement the composite design of the BES. Xiao Jian and Ye Minghan provided strong support and guidance. Colleagues at CERN and SLAC-LBL generously provided their programs. We extend our thanks to them all.

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LIFE SCIENCES

NEW HEMORRHAGIC SNAKE VENOM REPORTED

Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 16, No 3, Sep 86 pp 317-322

[Article by Huang Wanzhi [7806 1238 3112], Wang Chun [3769 3196], Hu Erding [5170 0059 0002], and Lu Zixian [7627 1311 6343] of Department of Biology, China University of Science and Technology: "Purification and Properties of a New Hemorrhagic Component Isolated From Agkistrodon (A.) Acutus Venom Discovered in South Anhui Mountain Areas"]

[Text] Abstract: Chromatographically using DEAE-Sephadex A-50, Sephadex G-75, DE52 fibrin and Sephadex G-100, a new hemorrhagic component, designated hemorrhagic-IV (AaH-IV), was isolated and purified from *A. acutus* snake venom. AaH-IV is a glycoprotein with caseinolytic and fibrinolytic activity but no enzymatic activity, resembling argininesterase; the molecular weight of AaH-IV is 51,000 and its pI is 5.4.

*A. acutus* is also called the five-step snake (said to kill a person within five steps after being bitten by the snake); it is a species of *Agkistrodon blomhoffi*. The snake venom is a blood-circulatory venom. One main cause of venom-induced death is widespread hemorrhaging in the victim. Snake bite hemorrhaging is probably due mainly to proteolytic enzyme in the snake venom, making the blood vessels more permeable. In the past, many studies were performed on isolating and purifying hemorrhagic venom from *A. acutus*; five hemorrhagic components were isolated from the venom of *A. acutus* (in Taiwan) by a research team of Meijo University, Japan. Four of the five components were found to lethal [1]. From *A. acutus* in the southern Anhui, Xu Xun [1776 3169] of China University of Science and Technology, purified three hemorrhagic components; all of them were determined to be lethal [2].

This article reports on another hemorrhagic component derived from *A. acutus* venom in southern Anhui. Based on the sequence named by Xu Xun, this new component is called hemorrhage-IV (AaH-IV); preliminarily, its physical and chemical properties are explored.

## I. Materials and Methods

### A. Materials

The *A. acutus* venom was obtained from snake bites at Qimen, Anhui. DEAE-Sephadex A-50, Sephadex G-75 and Sephadex G-100 are made by Pharmacia, Sweden. DE-52 fibrin is a product of Whatman Company in the United Kingdom. The standard protein comes from Combithek, West Germany; all other reagents are made in China, analytically pure.

Instruments: LKB 2117 multipurpose electrophoresis unit; double-light-beam ultraviolet spectrophotometer made by SPECORD UDVIS, East Germany; model 751 ultraviolet spectrophotometer made in China; and LKB chromatographic system.

### B. Methods

1. The molecular weight was measured, with SDS polypropylene amide gel flat plate electrophoresis, using the Weber method [3] on an LKB 2117 multipurpose electrophoresis unit.
2. Refer to Lu Zixian's method [4] for gel infiltering measurement of molecular weight, using Sephadex G-100 gel based chromatography, elutriant 0.15 M NaCl. Determine the water volume absorbed and adsorbed by the venom with N-acetyl, L-tyrosine ethylester hydrochlorate, and blue glucosan 2,000.
3. Based on the Wrigley method [5], measure the isoelectric point with an isoelectric focusing determination.
4. Sugar dyeing and quantitative analysis of sugar: use periodic acid as the Schiff reagent in sugar dyeing; the dyeing time is about 12 hours. Refer to the Dubois method [6] for quantitative determination of glucolipoids.
5. Refer to the Kunming Zoology Institute method [7] for the determination of caseinolytic activity.
6. Refer to the Kunming Zoology Institute method [7] for the determination of alkaline monoesterase phosphate and diesterase phosphate activities.
7. Refer to Qi Zhengwu's [2058 2973 2976] method [8] for the determination of argininesterasic activity.
8. Determine the L-amino acid enzyme oxide by determining amino production using Tusilei [transliteration] reagent.
9. Refer to the Marinetty method [9] for the determination of phosphorus esterase A.
10. To determine the thrombolytic activity, add human fibrinogen in a buffer solution of 0.1 M, pH 7.4 Tris-HCl to bring the mixture to an 0.4 percent concentration; add 0.5 ml of the mixture to a small test tube and then add 0.2 ml of the test sample in order to record the time when coagulation begins.

11. Based on Astrup's method [10], determine the fibrinolytic activity by using a fibrin flat plate, and an 0.05 M, pH 7.6 Tris-HCl buffer solution.
12. To examine hemorrhagic activity, shave off the fur from a white rabbit's back before intradermically injecting the venom sample. Twenty-four hours later, the rabbit was sacrificed and it was skinned for measurements of blood spot size and spread of hemorrhaging.
13. Determination of lethal activity: inject venom samples into the abdominal cavity of small white mice, each weighing  $20 \pm 2$  g. Observe how many mice die within 24 hours. Compute the LD<sub>50</sub> (lethal dose at which 50 percent of mice died) and perform an autopsy.

## II. Results

### A. Isolation of Crude Venom

1. DEAE-Sephadex A-50 chromatography: dissolve 2.0 g crude venom in 10 ml 0.02 M pH 8.0 Tris-HCl buffer solution; centrifuge to remove the insoluble content. The venom sample is then added to the upper-clear liquid for DEAE-Sephadex A-50 chromatography. A chromatogram is shown in Figure 1; the 12th constituent can cause a white mouse to bleed to death.

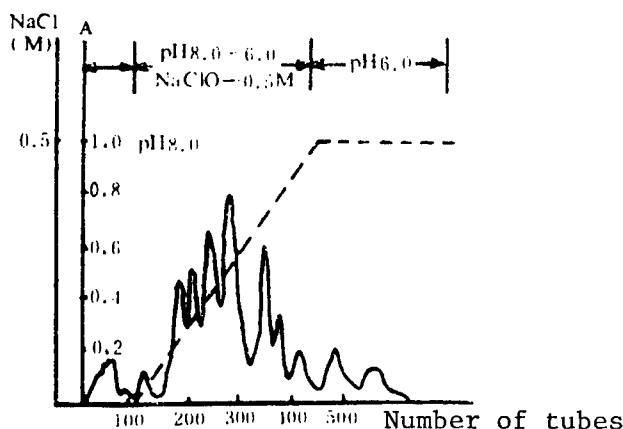


Figure 1. Crude Venom-DEAE Sephadex A-50 Chromatogram

Column:  $3.2 \times 100$  cm, 2.0 g sample; flow rate 24 ml/hr; collect one tube each 15 minutes. Elutriate with 0.01 M Tris-HCl. — A<sub>280</sub>; and --- NaCl concentration.

2. Sephadex G-75 chromatography: collect the 12th constituent mentioned above; reduce it down to a suitable volume with dialysis concentration. The constituent is then added to a Sephadex G-75 gel containing chromatography column. See Figure 2 for the chromatographic results; a lethal hemorrhage function is exhibited at the first protein peak, but it is not an electro-phoretically uniform constituent.

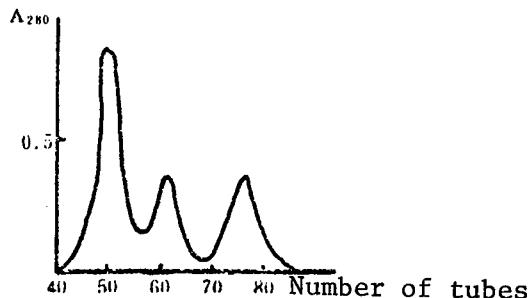


Figure 2. Sephadex G-75 Chromatogram of 12th Protein Peak of Crude Venom

Column: 1.8 x 100 cm; flow rate 12 ml/hr. Collect one tube each 20 minutes; elutriate with physiologic saline solution.

3. DE-52 fibrin containing column chromatography: collect the first protein peak mentioned above; the sample is then dissolved in an 0.05 M pH 7.0 Tris-HCl buffer solution following dialysis, cooling and drying. Add a sample to a DE-52 fibrin-containing chromatographic column. See Figure 3 for the chromatogram. Hemorrhagic activity is exhibited by both peaks, but peak I is higher in activity.

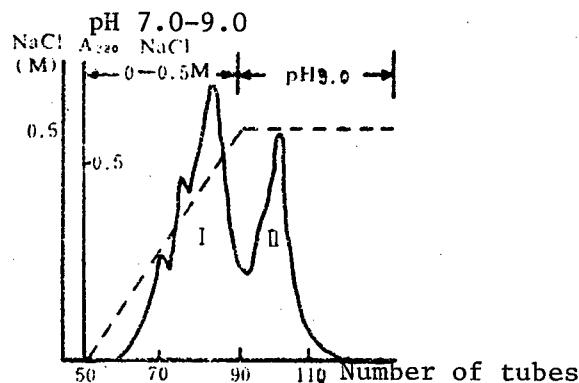


Figure 3. DE52 Fibrin-Purified AaH-IV Column Chromatogram

Column: 1.5 x 60 cm; flow rate 8 ml/hr; collect one tube each 30 minutes; 0.05 M Tris-HCl buffer solution.

— A<sub>280</sub>; - - - NaCl concentration.

4. Sephadex G-100 containing column chromatography: reduce peak I mentioned above with activity to a suitable volume following dialysis and concentration; then it is added to the Sephadex G-100 containing chromatography column. See Figure 4 for the chromatogram. Peaks II and III have hemorrhagic activity as proven with a hemorrhagic test. Peak II is uniform in SDS electrophoresis; this is the hemorrhagic (venom) component IV.

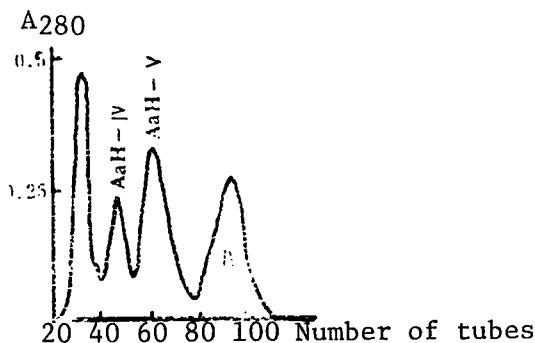


Figure 4. Sephadex G-100-Purified AaH-IV Chromatogram

Column: 1.5 x 60 cm; flow rate 6 ml/hr; collect one tube each 30 minutes; elutriate with physiologic saline solution.

#### B. Determination of Properties of Hemorrhagic (Venom) Component IV

1. Molecular weight: with gel filtration and SDS polypropylenamide gel electrophoresis, determine the molecular weights of hemorrhagic component IV as, respectively, 50,100 and 51,300 as shown in Figure 5.

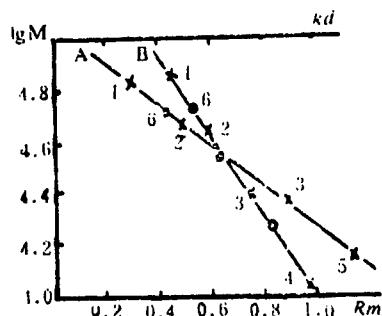


Figure 5. Determining Molecular Weight of Hemorrhagic Toxin IV

#### Key:

- A. Gel filtration using Sephadex G-100 column chromatography
- B. SDS-polypropylenamide gel electrophoresis
- 1. Bovine albumin
- 2. Albumin
- 3. Pancreas proteinase
- 4. Cell pigment
- 5. RNA
- 6. AaH-IV

2. Isoelectric point: use polypropylenamide gel for isoelectric point focusing electrophoresis; the isoelectric point of hemorrhagic venom IV is 5.4.

3. Determination of sugar: periodic acid-Schiff reagent staining of AaH-IV polypropylenamide electrophoresis gel stripes; the results indicate that the hemorrhagic component IV is glycoprotein; its hexose content is 4.4 percent.

4. Determination of fibrinolytic activity: by using the fibrin dissolving zone on a flat plate, the products of the maximum and minimum diameters indicate high or low fibrin solubility; see Table 1 for results.

5. Various enzymatic activities: see Table 2 for results of hemorrhage and LD<sub>50</sub> tests.

Table 1. Fibrinolytic Activity of AaH-IV

|  | Contrast (buffer solution) | AaH-IV |
|--|----------------------------|--------|
| Standard flat plate in mm <sup>2</sup> | 0                          | 120    |

Table 2. Enzymatic Activities of AaH-IV

| (1) 样品 | (2) 酶活 | (3) 项目 | (4) 酪蛋白水解酶 | (5) 精氨酸酯酶 | (6) 酸磷单酯酶和二酯酶 | (7) 磷酯酶 A | (8) L-氨基氧化酶 | (9) 凝血酶 | (10) 出血酶 | (11) 纤溶酶 | (12) LD <sub>50</sub> |
|--------|--------|--------|------------|-----------|---------------|-----------|-------------|---------|----------|----------|-----------------------|
| AaH-IV | +      | -      | -          | -         | -             | -         | -           | -       | +        | +        | 5.7 毫克 / 千克           |

Key:

1. Sample
2. Enzymatic activities
3. Items
4. Caseinolytic activity
5. Activity of arginineesterase
6. Activity of monoesterase phosphate and diesterase phosphate
7. Activity of phosphorus esterase
8. Activity of L-amino acid enzyme oxide
9. Activity of thrombase
10. Hemorrhage
11. Fibrinolytic activity
12. 5.7 mg/kg body weight

### III. Discussion

Chromatographically, using a DEAE-Sephadex A-50 column, the *A. acutus* venom was separated into 12 constituents; the 12th constituent was then isolated and purified, thereby deriving AaH-IV.

AaH-IV is a venom of the hemorrhagic lethal type. From an autopsy of small white mice, hemorrhage was found in the abdominal cavity and digestive tract with intestinal blistering, possibly caused by fibrinolytic and proteolytic enzyme functions; this is probably the main cause of death. Comparing the three hemorrhagic (venom) components purified by Xu Xun et al. [2], we can see from Table 3 that AaH-IV is a new hemorrhagic (venom) component.

Table 3. Comparison Between AaH-IV and Three Hemorrhagic (Venom) Components Purified by Xu Xun et al.

|                       | AaH-I                    | AaH-II               | AaH-III              | AaH-IV                   |
|-----------------------|--------------------------|----------------------|----------------------|--------------------------|
| Molecular weight      | 22,000                   | 22,000               | 22,000               | 51,000                   |
| Isoelectric point     | 4.6                      | 5.3                  | Greater than 9       | 5.4                      |
| Sugar content         | -                        | -                    | +                    | +                        |
| Caseinolytic activity | +                        | +                    | +                    | +                        |
| Fibrinolytic activity | +                        | +                    | +                    | +                        |
| LD <sub>50</sub>      | 2.8 mg/kg<br>body weight | Same as<br>left item | Same as<br>left item | 7.5 mg/kg<br>body weight |

Remark: Results of injection into abdominal cavity of small white mice for LD<sub>50</sub>.

Xu Xun reported [2] that in addition to discovering venoms I, II and III from *A. acutus* in South Anhui, at one time he isolated another hemorrhagic constituent, exhibiting proteolytic activity. However, in numerous batches of different batch-number samples that were isolated, AaH-IV repeatedly and consistently appears, with relatively high caseinolytic activity. Obviously, these two end products are not the same constituent.

From *A. acutus* in Taiwan, Mori and Sugiharactol [1] at Meijo University (Japan) isolated five kinds of hemorrhagic (venom) components. After a comparison, the authors discovered that the properties of AaH-IV are close to the AC<sub>3</sub> of the Japanese researchers, as shown in Table 4.

These two components may be caused by some differences traceable to the different localities and non-identical experimental methods, but these two possibly have the same function. Further study of the properties and functions of AaH-IV is needed.

Table 4. Comparison of AaH-IV and AC<sub>3</sub> Properties

|                        | AaH-IV                                     | AC <sub>3</sub>                            |
|------------------------|--|--|
| Molecular weight (SDS) | 51,000                                     | 57,000                                     |
| Isoelectric point      | 5.4  | 4.7  |
| Sugar content          | +  | +  |
| Caseinolytic activity  | +  | +  |
| LD <sub>50</sub>       | 150 µg per small white mouse weighing 20 g | 108 µg per small white mouse weighing 20 g |

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LIFE SCIENCES

RECENT ADVANCES IN PHARMACOLOGY OF CALCIUM CHANNEL

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 20, No 3,  
29 Mar 85 pp 235-240

[Article by Wang Zhengang [3769 2182 4858] and Yang Wu [2799 2976] of  
Pharmacology Laboratory, Department of Basics, Capital Medical University,  
Beijing]

[Abstract] The study of  $\text{Ca}^{2+}$  channel ( $\text{Ca}^{2+}$  and the functional protein regulating  $\text{Ca}^{2+}$ ) in pharmacology has become quite vigorous. It is anticipated that the study of this field will lead to the clinical treatment of the cell function weakening disease with  $\text{Ca}^{2+}$ . The paper describes the application of radioactive ligand radicals with experiments aimed at understanding the property of the  $\text{Ca}^{2+}$  channel, extraction and purification of protein molecules, research on antagonizers and activators, regulating function, and significance and prospects of research on the  $\text{Ca}^{2+}$  channel. The paper was received for publication on 13 July 1984.

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LIFE SCIENCES

IRREVERSIBLE LIGANDS OF OPIOID RECEPTORS, APPLICATIONS IN STUDY OF RECEPTORS

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 20, No 12, 29 Dec 85 pp 940-946

[Article by Li Mingxia [2621 2494 7209] and Jin Yinchang [6855 5593 2490] of Institute of Basic Medicine, Chinese Academy of Medical Sciences]

[Abstract] The first attempt at synthesizing irreversible ligands of opioid receptors was in 1968. Since then, for more than a decade many types of such irreversible ligands were synthesized. These ligands are widely used in studying opioid receptors, serving as a useful tool in isolating and purifying the receptors. This paper presents various molecular combinations of ligands and receptors, including the chemical alkylation ligands and photophilic irreversible ligands. The alkylation ligands can be used in studies *in vivo* and *in vitro*; the photophilic ligands can be generally used in experiments *in vitro*. The study and application of irreversible ligands of opioid receptors has yielded much data on ligands and receptors. Long effective ligands are introduced: oxymorphanzone, naltrexazone, naloxazone, Nz, and naloxanazine. A table shows structures of beta- and alpha-chloranaltrexamine (CNA).

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LIFE SCIENCES

CHLOROPHYLL DNA, CULTURING OF LIVERWORT MARCHANTIA POLYMORPHA L.

Shanghai XIBAO SHENGWUXUE ZAZHI [CHINESE JOURNAL OF CELL BIOLOGY] in Chinese  
Vol 8, No 3, Sep 86 pp 100-103

[Article by Xu Chanxing [1776 3934 5281], Shanghai Institute of Plant  
Physiology, Chinese Academy of Sciences]

[Abstract] Following the successful culturing of scar tissue of Oogametophyte of Marchantia (M.) polymorpha L. by K. Ono in 1973, some Japanese laboratories used it as research material but reports are few. This paper presents a follow-up study on the four following aspects: 1) culturing of Oogametophyte scar tissue of M. polymorpha L., 2) study of pendant drop culturing of M. polymorpha L., 3) culturing of M. polymorpha L. protoplast, 4) study of gene-block structure of chlorophyll DNA and its replication mechanism in M. polymorpha L.

Chloroplasts of cultured M. polymorpha L. cells grow well and the chlorophyll content is high, so this is a good research material for cell physiology and biochemistry, especially photosynthesis. The growth rate of this kind of cell is high while the doubling time is short, thus capable of synchronous culturing. In addition, this is a haploid cell, useful for studying heredity, especially genes. One table shows a comparison of the percentage content of culture medium composition and growth rate, and haploid cells of scar tissues. Two figures show the process of biogenesis, culturing and regeneration of protoplasts of M. polymorpha L., and the chlorophyll DNA physical spectrum for M. polymorpha L. The author is grateful to teachers Luo Shiwei [5012 1102 7279] and Li Wenan [2621 2429 1344] for their advice.

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LIFE SCIENCES

MODIFYING OF IgE IMMUNITY RESPONSE

Shanghai XIBAO SHENGWUXUE ZAZHI [CHINESE JOURNAL OF CELL BIOLOGY] in Chinese  
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[Article by Gu Hua [7357 5478], Institute of Cell Biology, Chinese Academy of Sciences]

[Abstract] The discovery that the IgE antibody is a medium for acute allergic-reaction diseases was followed by numerous studies on the physiological and biochemical properties of this antibody. Especially in recent years, there has been progress in the study of modifying the IgE antibody response, thus providing necessary knowledge for the final solution to curing allergy diseases with the IgE antibody as the medium. This paper briefly describes allergen properties, modification of the idiotype (Id) network of the IgE antibody response, interaction between T and B cells, and modifying due to the involvement of solubility factor. From the discussion in this paper, research on cellular and molecular mechanism of modification in the IgE antibody response has made rapid strides in the recent 10 or more years. The author is grateful to Professors Yao Xin [1202 9515] and Ye Min [5509 2404] for their advice.

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## ENVIRONMENTAL QUALITY

### FUTURE OF NUCLEAR POWER DISCUSSED

ZHONGGUO HUANJING BAO in Chinese 19 Feb 87 p 3

[Excerpt] Energy powers the four modernizations. An inadequate energy supply can seriously impair development of the country's national economy. Distribution of energy in China is extremely uneven. There is a shortage in east China, Guangdong, and Liaoning. In the noble aspiration to "develop the northwest," energy is of paramount importance. Development of nuclear power stations is an important way in which to solve the conflict between energy supply and demand in China. In this connection, the Qinshan nuclear power plant in Haiyan, Zhejiang and the Daya Bay nuclear power plant in Shenzhen, Guangdong Province are being constructed. China is about to enter the ranks of the nuclear power countries.

Nuclear energy is, after all, a young source of energy. There remain many problems in urgent need of thorough study, such as the environment and the nature of the effects of radiation. In China, in particular, we have experience only in the construction and operation of reactors; we still do not have experience in building or operating nuclear power stations. The accident at the Chernobyl nuclear power station in the USSR at a time when China's nuclear power ventures are just getting underway has inevitably increased the fears of an already suspicious public about the safety of nuclear energy and cast a shadow on the development of nuclear energy. However, it was also a beneficial negative lesson from which we who work in the field of nuclear environmental protection may draw a lesson. It reminded us that we must reevaluate and strengthen nuclear power plant environmental protection measures, and strengthen nuclear environmental protection laws in particular. We must accelerate and comprehensively study the evaluation of energy in terms of the environment in order to provide scientific data for the formulation of energy policies and to improve the quality of the environment. At the same time, we must accelerate study of nuclear power station substantive skills and management skills so as to improve the safety record of nuclear power stations.

We firmly believe that nuclear energy must become the main power for human society and that nuclear power stations are the optimum choice for solving mankind's environmental problems having to do with energy.

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## ENVIRONMENTAL QUALITY

### ENVIRONMENTAL PROTECTION STRATEGY, GOALS FOR 2000 OUTLINED

Beijing ZHONGGUO HUANJING BAO in Chinese 12 Feb 87 p 3

[Article by Qu Geping [2575 2706 1627]: "Analysis and Actions To Be Taken for the Realization by 2000 of Environmental Strategic Goals"]

[Text] When discussing strategic plans for the environment by the year 2000, the real environmental situation we face should be studied diligently. Only when the actual situation faced is correctly understood will environmental planning fairly well approximate the actual situation. There are both some favorable aspects and some unfavorable aspects to be faced in the realization of strategic environmental plans by the year 2000; consequently, we must make a full appraisal of both aspects.

#### Unfavorable Aspects

1. Environmental problems are numerous; pollution is fairly severe and the clean up task is strenuous. Environmental pollution is general in 324 cities. For example, the extent of pollution of the atmosphere and of water in some countries has surpassed that of the rampant period of the 1950's and the early 1960's. China, with a poor economic foundation, processes only 2.4 percent of its sewage and has a coal gasification rate of only 24 percent. It owes a great debt to the environment. In addition, the appearance in recent years of township enterprise pollution problems has very severely damaged the agricultural environment. The deterioration of the national environment that we face in a low forest cover rate and steadily increasing degeneration of grasslands will not be easily reversed within a short period of time. In short, we have a fairly long history of destroying nature. In addition, population continues to increase dramatically, the rate of increase being between 1.3 and 1.4 percent annually. This places increasingly great pressure on the natural environment.

2. The country lacks sufficient economic strength; funds that may be allocated for cleaning up the environment are very limited. No cleaning up is possible that does not take account of the economy. The economy is of decisive importance in how much money the country can spend and how much cleaning up can be done. Right now the country's economy is developing fairly rapidly; nevertheless, the GNP is only \$300 per capita. When considering problems, we cannot use the standards of developed countries to set standards for cleaning up our own environment.

3. Our industry's technical equipment is antiquated, most of it at the international level of the 1950's or 1960's, and the task of transforming it is a daunting one. Because their technical equipment is advanced, the extent of pollution in some developed countries is fairly light, comparatively speaking. Since our equipment is inferior, difficulties in the prevention and control of pollution are very great. Currently the main source of pollution is industry.

4. The environmental problems caused by the use of coal as the primary source of energy are truly very great. Because China burns coal, atmospheric pollution resulting from coal smoke is extremely serious. This is particularly the case in north China cities. Use of coal as a primary source of energy is not likely to change greatly between now and the year 2000. This state of affairs is not only fundamentally different from that in Western countries, but is no different from in other Asian countries.

5. Environmental rules and regulations and a system of laws remain very imperfect, nor are laws strictly enforced. The problems occurring today are related to our building of a legal system.

#### Favorable Aspects

1. The plans and policies for economic development that the country has instituted provide extremely favorable conditions for environmental protection. Agricultural programs have changed from the former taking of grain as the key link, to positively no relaxation of grain production and active expansion of economic diversification. These programs have been particularly important in protecting the natural environment. With the current readjustment of agricultural programs, not only has agricultural production undergone very great changes, but these programs have served to guide the launching of agricultural zoning, by which is meant the drawing up of agricultural development plans on the basis of different geographical, environmental, and climatic conditions. For example, for the severely eroded areas of northwest China, programs have been instituted in which animal husbandry is paramount for the growing of trees and the planting of grass. These programs have produced remarkable results.

We have also instituted new programs for environmental protection work as, for example, adherence to environmental protection as our fundamental national policy, and adherence to a policy of firm attention to "three steps at the same time" and "three benefits," as well as some specific policies associated with these programs, which are very significant. However, some comrades maintain that no matter how good our policies, they are still only propaganda. This is a wrong view. These programs are of decisive significance in environmental protection work. Correct policies can lead to improvement of the environment, and improper policies can lead to deterioration of the environment. Therefore, we should realize the power of programs and policies.

2. The state has made environmental protection an important component of its intermediate- and long-range planning as, for example, in the National Land Plan and in Plans For the Development of Science and Technology, the Economy

and Society by the Year 2000 drafted by the State Planning Commission. This marks a very great change in conception. For environmental protection to be regarded not as an ad hoc- but rather as a long-term plan is of major significance.

3. It was during the Sixth 5-Year Plan that greatest progress was made in controlling pollution, and this was manifested most conspicuously in regard to industry. There was 85-percent compliance with the "three simultaneous" in new construction, expansion, and remodeling projects, new sources of pollution being effectively controlled. Old enterprises also took some important actions to control environmental pollution. As a result of the actions taken in both regards, pollution was reduced despite tremendous development of production and tremendous increase of energy. In addition, state-mandated plans for the expansion of reproduction by intensive methods of developing industrial production, by which was meant taking the road of technical transformation and taking the road of reducing pollution and lowering consumption, brought about a fine situation for environmental protection work. We should make a full appraisal of the significance of technical progress for protection of the environment and for the prevention and control of pollution.

4. With the expansion of enterprises' self-determination not only were the enterprises' own responsibilities for prevention and control of pollution clarified, but they also had the ability to prevent and control it. Mostly industries themselves must be relied on to control industrial pollution. Without the active participation of industrial plants, prevention and control of pollution is an empty phrase. Expansion of enterprises' self-determination is helpful in preventing and controlling pollution. In addition, reform of the economic system providing for a separation of party and government functions and political and entrepreneurial functions also benefits environmental control. For example, it clarifies the important functions of government at all levels in environmental protection.

5. According to 1985 statistics, 319, or 98 percent, of 324 cities throughout the country have prepared overall plans. The county seats in 1,710 of 2,000, or 85 percent, of the counties have made plans. Environmental protection has an important place in all these city plans. I believe that urban environmental problems are attributable largely to plan inadequacies. When planning is done well and the pattern for urban development is rational, even though pollution may not be controlled, the situation will still be better than at present. The soundness of urban plans holds important significance for environmental protection.

6. The problem of setting up an organization. We already have a fairly large corps of people with a certain amount of experience in control and research for the establishment of environmental control organizations and research organizations from the national level on down through every level of government. In particular, establishment by the State Council of an environmental protection committee has been of major significance in environmental protection endeavors. The condition of China's environment today depends to a very great extent on control. Without a corps that both understands control and understands techniques, it is difficult to do anything.

7. Raising environmental consciousness. Thanks to our energetic propagandizing during the past several years, the environmental consciousness of leaders at all levels has been raised. This so-called raising of environmental consciousness means, first of all, raising leaders' consciousness of the environment, for without action on their part, nothing can be done easily. Take Tianjin, for example, which was formerly a severely polluted city. That it has changed so quickly during the past several years is attributable mainly to the fairly high environmental consciousness of its leaders.

In analyzing these favorable and unfavorable aspects, the favorable conditions predominate and the trend is toward their continued rise. Therefore, we should take heart and not feel that the problems are too numerous or lack confidence whenever the subject of environmental protection comes up. There are indeed numerous difficulties, but there are things we can do. The country's future is bright, and the future for our environmental protection endeavors is likewise bright.

#### Actions To Be Taken To Realize the Environmental Plan Goals For the Year 2000

Forecasts call for a gradual increase in the country's environmental pollution between now and 1995, with 1995 being the peak period for environmental pollution. After 1995, environmental quality will begin to change for the better. In order to bring about a fundamental change for the better in environmental pollution, not only is it necessary to increase investment in environmental protection now, but the following actions must also be taken:

1. Perfection of rules and regulation. For example, rules and regulations pertaining to the major environmental fields of the atmosphere, water, solid wastes, noise, radiation, toxic chemicals, and natural protection should be established and perfected. At the same time, various environmental standards that correspond with the rules and regulations should be drawn up. Local standards are of even greater significance. Since China is a very large country in which natural, social, and economic conditions vary from place to place, separate standards should be applied.
2. Promulgation of new policy measures. Practice has demonstrated prevailing policies to be effective, and they should continue to be implemented. Policies that should be formulated include the following: a) Policies regarding multiple use of resources. There are a number of problems in this regard that require the adoption of workable and effective policies. b) Policies on harmless and low-harm technologies. This applies particularly to machine manufacturing industries for whom requirements must be raised. They should not be allowed to manufacture boilers that we have to alter. This cycle cannot be allowed to continue. We must place environmental requirements on units that produce mechanical equipment; there should be policy regulations for them. Policies should have standards to match. For example, there should be standards for 1990 and standards for 1995. We cannot have a single standard that continues to be used forever without change. c) A briquet coal policy. By the year 2,000, in addition to using coal gas and heat supplied from a central point, the main link in solving atmospheric pollution will be briquet coal. If briquet coal use increases, even should energy quadruple, pollution can be cut

by half. Atmospheric quality can be controlled through this single action alone without resort to any other; therefore compulsory actions must be taken on this problem. d) Though there are currently some policy regulations for the control of township industrial pollution, these require continued perfection. e) In addition to policy regulations for control of toxic chemicals, there should be policy coordination among units concerned, i.e., the coordination of pertinent policies. For example, coordination problems exist among interrelated economic, S&T, educational, finance, and trade policies. We have noted earlier the insufficient coordination in these regards.

3. Intensification of propaganda to raise environmental consciousness. This is something that should continue to be intensified. It seems worthwhile to spend some money on propaganda.

4. Strengthening of environmental control. Establishment of a corps that is professionally qualified and that understands control for the country, local jurisdictions, and all sectors. The strengthening of supervisory functions in environmental control is particularly important.

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## ENVIRONMENTAL QUALITY

### UNITING ENVIRONMENTAL PROTECTION, ECONOMIC POLICIES URGED

Beijing ZHONGGUO HUANJING BAO in Chinese 12 Feb 87 p 3

[Article by Zhou Fuxiang [0719 1381 4382]: "Need For Serious Study of the Matching of Environmental Policies With Other Policies"]

[Text] During the Sixth 5-Year Plan, China formulated a series of environmental protection programs and policies that played a major role in the prevention and control of pollution and in the protection of the ecological environment. In studying plans for environmental protection by the year 2000, special attention should be devoted to matching environmental protection with interrelated economic, social, and S&T policies. Environmental policies should permeate economic, social, and S&T policies, environmental protection thereby being coordinated in policy terms with economic, social, and S&T development.

#### I. The Matching of Economic Policies and Environmental Policies

Given China's current economically backward conditions, the focus of environmental policies should be on helping sustained and stable economic development, basing gradual improvement of the environment on development of the economy. Economic policies should help steady improvement of environmental quality; there can be no sacrificing of the environment in a quest for development. In line with this principle, policies requiring further study and discussion are as follows:

##### A. Environmental Control Strategy

There are two strategies for environmental control. The first is to regard environmental control as a social problem, relying on standards and regulations to limit activities damaging to the environment. This was the environmental control strategy that developed Western countries adopted during the 1960's and 1970's. In China, this is termed negative-feedback control. The other is to make environmental control an integral part of economic work, taking actions that coordinate rational plans with economic policies to promote equitable use of environmental resources to reduce or eliminate damage to the environment. This is the environmental control strategy that numerous countries have adopted during the 1980's. In China, this is termed positive control. I maintain that the latter form of environmental control should be adopted, applying standards and regulations at the same time to attain a coordinated goal.

## B. Perfection of Action and Restraint Mechanisms To Control Pollution by Industrial Enterprises

Control of industrial pollution is the key to environmental pollution. During 1987, China will formulate a series of policies for the further enlivening of large and medium-size enterprises so that they can truly become enterprises with the vitality for self-transformation, self-accumulation, and self-development. Loosening up and enlivening of enterprises is favorable for environmental protection, but it can also be unfavorable. Enterprises may pursue short-term goals, thinking only about their internal economic situation and neglecting the external economic situation. They may not want to spend money to clean up pollution that produces no benefits. Consequently, it is necessary to employ various methods, particularly economic methods, that combine control mechanisms at the plant level with overall controls to impel enterprises to set up both action and restraint mechanisms for control of pollution themselves. It is particularly necessary to link pollution control machinery with national policies for the enlivening of large and medium-size enterprises so that enterprises will give serious attention to environmental protection simultaneous with their enlivening.

## C. Development of Agriculture and Protection of the Agricultural Environment

China's rural development currently has four models as follows: a) The Zhu Jiang Delta model that relies on its close geographical proximity to Hong Kong to bring in materials for processing and compensation trade to expand exports of electrical appliances, clothing, plastic wares and such products of light industry and the electronics industry. 2) The southern Jiangsu model that relies on advantages in being close to large cities for the development of township industries. c) The Wenzhou model for the development of cottage industries, mostly for the production of small goods. d) The Hai'an model for the development of ecoagriculture and for the establishment of processing enterprises primarily for agricultural and sideline products. There may be other models as well. Generally speaking, it is the Hai'an model that is of generally greater significance for economically undeveloped rural villages. Not only can it better bring about a benign cycle in agriculture and promote the all-around development of farming, forestry, animal husbandry, fisheries and sideline occupations, but it can simultaneously bring about a linking of the development of township industries with agricultural production, increase the added value of agricultural products, increase peasant income and improve the rural environment. Protection of the agricultural environment requires a conscientious summarization and the spread of ecoagriculture as its work emphasis, thereby closely correlating protection of the agricultural environment and rural development.

## II. Matching Social and Environmental Policies

### A. Matching of Consumption and Environmental Policies

The pollutants discharged as a result of the consumption activities of the residents of some large cities have increasingly become conspicuous environmental problems. Consequently, serious attention must be given to the

matching of consumption policies and environmental policies. For example, small motor vehicles have proliferated very rapidly in many cities, traffic pollution is becoming increasingly prominent as a result. Depending on what future consumption policies the country adopts, if consumption increases at the present rate, it is very likely that by 2000 an increasing number of people will buy small motor vehicles and urban traffic pollution will become an environmental headache such as it already is in some developed countries. If we act promptly to guide consumption as, for example, by commercializing housing, urging private ownership of houses so that consumption demand shifts from motor vehicles to houses, obviously such a consumption policy would benefit environmental protection.

Another example is the replacement of bottled beer with canned beer in the markets, and the replacement of milk in glass bottles with milk in plastic bags. A very great change has occurred in the waste products of urban life, which formerly consisted primarily of vegetables, bricks, and tiles. These have been replaced by wastes that cannot be readily processed. No longer can traditional methods be used to dispose of urban wastes; instead expensive disposal methods are necessary. Therefore, in terms of environmental protection, there also exists a problem of guiding consumption as regards food packaging.

#### B. Policies on the Use and Processing of Nightsoil

With development of the rural economy, some peasants prefer to use chemical fertilizer rather than use nightsoil as fertilizer, so many cities and county seats have no choice but to discharge nightsoil into streams, thereby polluting water sources. The government will spend large sums of money to clean up this pollution. In addition, each year the country has to spend large amounts of foreign exchange to import several million tons of chemical fertilizer, and it has to draw large sums to subsidize production plants so that chemical fertilizer may be sold to peasants at a low price. The country bears a double burden of expense. There is a policy guidance problem in this as well. It is necessary both to support the development of agricultural production and to help use nightsoil to reduce the burden on the country. This is also a problem in the matching of policies that requires study.

### III. Matching of Policies on Science and Technology With Environmental Policies

The development of science and technology (including high technology) occasions new environmental problems, and solution to these environmental problems requires reliance on advances in science and technology. Consequently, mutual coordination of policies is required.

A. The design of industrial products, particularly the design of mechanical products has to begin with structural improvements in order to reduce or avoid environmental damage from their use. For example, mechanical products, such as motor vehicles, boilers, blowers and compressors, should be designed with environmental protection requirements in mind, and none should leave the plant only to have to be rebuilt one by one. Consideration might be given to an environmental protection permit system whereby products failing to meet

environmental standards are not permitted to leave the factory.

B. The industrial process has to energetically promote pollution-free or slight pollution technologies and develop closed cycles. Practice has demonstrated economic benefits from pollution-free technologies to be higher than from conventional technologies. In cases where economic benefits are lower than from conventional technologies, the adoption of environmental protection subsidy policies should be considered to support and popularize their use. In terms of social benefits, this action would be more economical than spending money to clean up pollution and it would also help in shifting from conventional technology to pollution-free new technology.

C. Development of Multiple Uses To Accelerate the Conversion of Waste to Wealth

Lack of resources is a fundamental element limiting the speed of the country's development. Increase in the resources utilization rate is an important way in which to shift from nonintensive operations to intensive operations, and it is also an important policy for the country in making a change from extensive to intensive methods in the expansion of reproduction. S&T policies have to serve economic development, strive to develop new techniques for the multiple use of resources, and pioneer new techniques for converting waste to wealth, thereby completely coordinating S&T qualities with economic policies and environmental policies.

In addition, environmental protection plans for 2000 should devote attention to global environmental problems. For example, various countries are generally concerned about climatic changes resulting from a rise in the atmosphere's carbon dioxide content and about "holes" appearing in the ozone layer of the atmosphere at the north and south poles. We must both keep track of and collect information, and we must organize forces to launch a study of how global environmental changes may affect China's environment.

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## ENVIRONMENTAL QUALITY

### INVESTING 1.5 PERCENT OF GNP TO PROTECT ENVIRONMENT URGED

Beijing ZHONGGUO HUANJING BAO in Chinese 12 Feb 87 p 3

[Article by Li Jinchang [2621 6855 2490]: "Suitable Increase in Environmental Protection Investment Is a Strategic Measure"; first two paragraphs are source-supplied introduction]

[Text] Editor's Note: In December 1986, the Planning Department of the State Environmental Protection Bureau convened a discussion meeting on major environmental protection problems in 2000. At this meeting, the State Environmental Protection Bureau director, Comrade Qu Geping [2575 2706 1627], as well as experts and scholars expressed important views about the state of the country's environment and the trend of developments by the year 2000. We have prepared this draft on the basis of their statements.

Environmental problems have gone through a fairly long period from their inception to their development. Discussion of environmental problems in 2000 is but a beginning. It is hoped that the vast numbers of people working on the environment will discuss and study this issue in greater depth in order to give impetus to the development of strategic study of China's environment.

It is generally believed that by strengthening control, environmental pollutants can be reduced approximately 50 percent. However, without funds or without sufficient funds, any fundamental solution to the pollution problem is not feasible. Appropriate increases in environmental protection investment is an important requirement for prevention and control of industrial pollution from the "three wastes" [waste water, waste gas, and industrial residue] and for protecting and improving the environment.

### Chinese and Foreign Experiences With Investment in Environmental Protection

Both Chinese and foreign experiences show that cleaning up the environment takes quite a lot of money and time. When construction is done without consideration of the environment, money is saved, but later on when environmental problems arise, the cleanup requires that a lot of money be spent. A very expensive price is paid. Furthermore, as the economy develops and the people's standard of living goes up, requirements for environmental quality and for environmental control standards rise correspondingly, and then there is a dramatic rise in expenditures for the environment.

Since the late 1960's, there has been a year-by-year rise in the percentage of the GNP that industrially developed countries have invested in environmental protection. After reaching 2 percent in the mid-1970's, it stabilized and dropped gradually thereafter. This resulted from the substantial saturation resulting from the addition of environmental protection equipment and the installation of pollution prevention and control equipment in enterprises. During the late 1970's, numerous countries proposed environmental comfort goals as a result of which requirements for environmental quality and standards for environmental control became higher. Once these requirements had been translated into regulations, investment in environmental protection might also increase dramatically. For example, foreign data show that the cost will be 100 times greater for a plant if it is not permitted to discharge any organic wastes than if it is permitted to discharge wastes from which 30 percent of organic matter has been removed. Other data show that after 2020, investment in environmental protection by industrially developed countries may reach 5 or 6 percent of GNP.

The lessons for China regarding investment in environmental protection are profound. Inasmuch as virtually no consideration has been given to environmental problems in building the economy during the 30 years since founding of the People's Republic, the minimum estimate is for a bill of approximately 50 billion yuan. However, economic losses growing out of environmental pollution now exceed this figure each year.

#### Environmental Protection Investment Plans Have To Be Implemented and Channels Have To Remain Open

In order to insure the continued healthy development of the country's economy and society and to realize the magnificent goal of the "four modernizations," the party and government have designated environmental protection a fundamental national policy and they have formulated a general program of synchronous planning, implementation, and development for building the economy, the cities and towns, and the environment. The first link in implementation of this overall program is to make environmental protection a part of national economic plans, insuring an amount for investment in environmental protection and spelling out the proportion of investment in environmental protection, using overall balance to bring about a mutually coordinated, healthy and sustained development of the population, resources, the environment and the economy.

There are rational limits to investment in environmental protection. Too little, and the trend toward a worsening of the environment cannot be controlled, much less can there be any talk about improvement of environmental quality. Too much, and economic development will be impaired and national strength will be diminished even though the environment can be controlled and improved. Results from the investment will also be far from ideal. Only when investment in the environment is appropriate will it be possible to show concurrent concern for the two goals of environmental protection and development of the economy so that the economy and the environment help each other advance in coordinated development. In view of China's present circumstances and national power, such an appropriate investment in environmental protection should be approximately 1.5 percent of national

income. This will require tripling the present 0.5 percent. Without doubt, this will be a very great burden for the country. However, if it is realized that the huge economic losses that will be avoided and the considerable economic benefits that will be gained will vastly outweigh the investment (a 1-yuan investment in environmental protection can achieve as much as 6.60 yuan spent for clean up), this would not seem to be a difficult decision.

Of course, not all of such a large investment in environmental protection can be borne by the national treasury. We will have to abide by the principles of "the one who pollutes is the one to clean up," and "the one who develops is the one who protects," adopting a policy whereby local jurisdictions, departments and entrepreneurial units mostly provide the money themselves, with the state making supplemental appropriations in broadening avenues so that many parties pool funds for environmental protection. This can both stir the enthusiasm of all parties, reduce the burden on the national treasury and hasten prevention and control of pollution from the "three wastes" for the protection and improvement of the environment.

Specifically, environmental protection has to be made a part of national, department, local, and entrepreneurial unit economic construction plans, and provision has to be made to keep channels open for environmental protection funds. Currently, the country's environmental protection funds come primarily from the following sources: First is major enterprises' environmental protection projects, such as major clean up projects and the building of scientific research units and monitoring systems, which the state has made part of the plan and for which special funds are disbursed. Second is new construction, renovation and expansion projects for which an environmental impact evaluation system is used and for which the principle of "three simultaneous" is applied for making payments. These payments are made a part of the plan for investment in fixed assets. Third, 7 percent of the funds that each department and each enterprise have at their disposal for replacement and improvements have to be spent on pollution cleanup. Collective enterprises' pollution-cleanup funds have to be taken from "public accumulation funds," "the cooperative enterprise fund" or from "replacement and improvement funds." Fourth, large and medium-size cities will have to withdraw a certain percentage of funds from maintenance expenses and use them to construct integrated environmental pollution prevention and control projects. This construction should be done in combination with the building of basic urban facilities. Fifth, 80 percent of payments by enterprises for the discharge of pollutants are to be used to clean up pollution in enterprises or in departments responsible for work; the other 20 percent is to be used in overall area pollution prevention and control, for monitoring of the environment and for propaganda and education. Sixth, profits on goods obtained as a result of making multiple uses of resources as part of plant and mine pollution prevention and control are not to be paid to the state during the Seventh 5-Year Plan; instead they are to be retained by enterprises to clean up pollution further and as funds for making multiple use of resources.

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## ENVIRONMENTAL QUALITY

### MEDIUM, SMALL CITIES SEEN AS MAIN FUTURE WATER POLLUTERS

Beijing ZHONGGUO HUANJING BAO in Chinese 21 Feb 87 p 3

[Article: "Environmental Pollution of Water to Hold an Important Future Position in China's Medium and Small Cities a Survey of 57 Cities Shows"]

[Text] Results of a comprehensive study of potential effects on the water environment growing out of checks made in cities of different sizes in which 37 [as published] large, medium, and small cities were used as specimens including Tianjin, Shanghai, Harbin, Shenyang, Nanjing, Chongqing, Baotou, Jilin, Lanzhou, Dalian, Fushun, Shijiazhuang, Wuxi, Changzhou, Suzhou, Guiyang, Jinzhou, Jiaozuo, Ningbo, Lianyungang, Guilin, Shenzhen, Zhuhai, and Tumen showed the following: The speed of economic development and the speed of population increase in different size cities varied, and the effect on the water environment also varied. In general, the gross output value of urban industry, the rate of population increase, and the industrial waste water coefficients of elasticity were inversely proportional to the size of the city. This showed the technical level, the management level, and the economic strength of large cities to be superior to that of medium and small cities.

In China today, large cities hold the lead in urban environmental pollution of water, and they are the focus of urban water pollution prevention and control. However, the situation will be different by the year 2000 when today's medium and small cities will graduate to important positions. Accompanying the steady succession in the urbanization process, medium and small cities will develop rapidly in the next 10 years or more. Cities such as Shenzhen, Yancheng, and Lianyungang will have populations of 800,000, 250,000, and 900,000 by 2000 and their GVIO will reach 12 billion, 2.6 billion, and 13.4 billion yuan, respectively. Cities such as Huaiyin, Jiaozu, Ningbo, Jingtai, Qinhuangdao, and Wenzhou will have populations of between 500,000 and 1 million and they will develop into cities with populations of more than 1 million. In terms of the rate of development, development from a small city to a medium-size city or from a medium-size city to a large city will be at a faster rate than development from a large city to an exceptionally large city. However, the present level of production technology, the level of management, and the economic strength of medium and small cities is quite far from that of large cities, but in the economic takeoff of the next 10 years or more, a potential exists for "polluting first and cleaning up later." Though large cities are foremost in the volume of pollutants discharged into the water environment, the future rate of growth of the quantity of pollutants discharged by small

cities will be markedly higher than for large cities. This point has already been attested by evaluation results. Consequently, the emphasis in cleaning up the water environment will have to shift to medium and small cities in order to guard against the potential pollution that can be created by medium and small cities during modern urbanization. It is necessary to begin now to formulate long-range strategic plans for the development of medium and small cities, paying attention to a rational pattern of distribution for industries and doing all possible to adopt advanced technology.

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## ENVIRONMENTAL QUALITY

### NATIONAL POLLUTION CONTROL GOALS DETAILED

Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese  
No 1, 20 Feb 87 pp 1-3

[Article by Qu Geping [2575 2706 1627], director of the State Environmental Protection Bureau Beijing: "China's Goals For the Control of Environmental Pollution"; compiled from a speech given on 9 December 1986 at a forum on major Chinese environmental problems; first paragraph is source-supplied abstract]

[Text] This article, which is an analysis in terms of experts' scientific predictions and investigative studies and an examination in terms of China's economic strength, holds that by 1995 most of the country's pollution can be substantially controlled, and that between 1995 and 2000 the country's environment should see improvement. Realization of this goal requires a series of actions. As Vice Premier Li Peng [2621 7720] pointed out, pollution control will depend first on policies, second on science, and third on control. These actions are also consistent with realization of the year 2000 goals.

When we draw up environmental plan goals, we have to start with realities as they exist in China. The realities we face are as follows: Though there are numerous favorable factors, there are also numerous unfavorable factors; however, the favorable factors are on the increase and the unfavorable factors are being steadily overcome. We positively cannot formulate goals that past efforts have shown to be incapable of realization. We have some lessons of experience in this regard. However, neither can we irresolutely shrink from those goals that can be realized with effort. This latter tendency bears watching at the present time.

At the Second National Environmental Protection Conference, Vice Minister Li Peng pointed out that among the environmental goals for 2000, the goal for the prevention and control of environmental pollution is as follows: Full control of environmental pollution and improvement of environmental quality in a large number of cities. Some people dissented from this goal, considering it too high and unattainable. Comrades attending the current forum discussed this goal, deciding that it was not too high and that not only could it be achieved with effort, but it could be achieved ahead of time. The virtually unanimous view was that by 1995 the spread of pollution could be substantially halted,

and that by 2000 environmental quality would markedly improve in an overwhelming number of cities. Achievement of this acknowledgment was a positive accomplishment.

Is there any basis for the assertion that the goal is attainable? I maintain that there is.

First, spread of the cause of environmental protection during the Sixth 5-Year Plan, and particularly control over the spread of pollution provides such a basis. Comparison of 1985 with 1980 shows a marked decline in discharge of the "three wastes" [waste water, waste gas and industrial residues]. Industrial waste water dropped from 447 tons to 310 tons [as published], down 35 percent; sulfur dioxide fell from 0.53 tons to 0.16 tons in a 70 percent decline; smoke and dust declined from 0.30 tons to 0.16 tons, down 47 percent; and solid residues fell from 9.8 tons to 6.3 tons, down 36 percent. In industrial waste water, the greatest decline was in seven toxicants as follows: Mercury, 79.4 percent, cadmium, 28.2 percent; 6-valence chromium, 76.5 percent; arsenic, 83.6 percent; aluminum 51.8 percent; acids, 73.9 percent; and oxidants 57.9 percent.

During the Sixth 5-Year Plan, industrial output value rose 65 percent while the amount of pollutants discharged fell. This was a very great advance and a change from the past tendency for pollutants to increase as output value increased.

On the other hand, a look at urban atmospheric quality shows no great change between 1980 and 1985. Sulfur dioxide declined from 0.11 to 0.092 milligrams per cubic meter; nitrogen monoxide, dioxide and trioxide dropped from 0.043 to 0.042 milligrams per cubic meter; particulates rose from 0.61 to 0.66 milligrams per cubic meter; and falling dust dropped from 35 to 29.2 tons per month per sq km. There was no marked deterioration in water pollution. In noise control, statistics from Beijing, Xian, Shenyang, and Jilin show varying degrees of abatement.

Despite the rapid expansion of industrial production, steady population increase, and a tremendous rise in energy consumption, urban environmental quality showed no corresponding deterioration, demonstrating a strengthening of ability to control pollution. This strengthening of ability to prevent and control pollution took place without much investment in environmental pollution and without the adoption of very many advanced techniques for pollution prevention and control. It was achieved mostly through the strengthening of controls. Why is it so hard to imagine that with strengthening of the national economy and technical progress even greater advances can be made during the Seventh Year Plan and thereafter?

Second is the need for a full estimate of changes wrought on the environment as a result of technical advances in industry. Expansion of China's industry has relied on a policy of expansion of reproduction through intension, which is to say the adoption of new technologies and new techniques to expand production ability. By 2000, industrial techniques will have attained the international level of the late 1970's and early 1980's. Accompanying advances in technology will be a tremendous decline in the consumption of energy and

raw materials and a reduction in the discharge of industrial pollutants. This plus measures for effective treatment of the "three wastes" will bring about a very great increase in the level of prevention and control of industrial pollution. This is extremely favorable for control of environmental pollution.

Third, with the development of city planning and construction, ability to prevent and control environmental pollution will rise markedly. Statistics for 1985 show that 319 of 324 cities throughout China, or 98 percent, have completed overall development plans. Of 2,014 county seats, 1,710, or 85 percent, have completed overall development plans. All have paid attention to environmental protection requirements in city planning. This is a measure of decisive significance for protection and improvement of the urban environment. In addition, development plans for providing heat from central sources, the urban gasification rate, and the sewage treatment rate show that a comprehensive cleanup of the urban environment can produce various changes in the environment.

|                                | Central Heating<br>percent | Urban Gasification<br>Rate<br>percent | Sewage Treatment<br>Rate<br>percent |
|--------------------------------|----------------------------|---------------------------------------|-------------------------------------|
| 1980                           | 2                          | 15                                    | --                                  |
| 1985                           | 7                          | 24                                    | 2.4                                 |
| 1990 (Large, medium<br>cities) | 20-40                      | 40-60                                 | 10-30                               |

When we look at the environmental protection picture, we should realize the development that has taken place in this regard. Currently all jurisdictions are accelerating the pace of urban modernization on the basis of overall city plan requirements. As urban construction expands, changes in the urban environment will occur very rapidly.

Fourth, since the publication in 1982 of the forecast study titled, "China's Environment in 2000," extrapolative studies using a large amount of checking and various kinds of mathematical models have shown the following: Were 1.5 percent of national income to be used for environmental protection, with a little readjustment of current environmental standards and with the addition of control measures, the environmental situation would begin to change for the better by 1995, and by 2000 there would be a rather marked improvement in the urban environment. The views expressed in discussions at the forum were synonymous with the findings of the forecast study.

Fifth, during the past 10 years and more, and notably since the Sixth 5-Year Plan, the state has promulgated a series of environmental protection programs, policies, laws, and regulations. In 1983, it also proposed a plan for synchronous planning, synchronous implementation, and synchronous development in building the economy, building cities and towns, and building the environment. In order to put this plan into effect, the state revised or reformulated some specific policies and regulations. Practice has demonstrated the institution of these policies to have been correct, effective, and in keeping with China's national circumstances. Certainly this is not to say that these policies were perfect in every way. In the future, it will be necessary to continue diligent study of policy issues to make them

full and complete. Policies are decisive links in environmental protection. Today, China has an overall program for environmental protection and it also has numerous specific policies. This point is of extraordinary importance for realization of environmental goals in 2000.

The foregoing has enumerated data in five different regards. Actually, more factors might be listed. But a look at these data and factors alone shows the realization of environmental goals by 1995 to be possible.

Of course, the environmental problems we face are serious. Take urban atmospheric pollution, for example, which in 1985 was generally at the same level as in 1980. Moreover, the 1980 level was very poor. Specifically, the density of particulate matter was high, two or three times more than the standard. It is no easy matter to change this state of affairs. Water pollution is yet another large problem that cities face. The treatment rate is currently very low, and difficulties are very great in the secondary treatment of more than 30 billion cubic meters of waste water. Garbage and noise problems are also very prominent. These problems cannot be glossed over; they must be faced squarely. The goal of facing them squarely is to devise solutions for them. We cannot recoil in the face of problems and difficulties or lose confidence. Today, the people of the whole country are confidently forging ahead courageously to attain the goal of quadrupling the gross output value of industry and agriculture. Environmental workers must do likewise; they must confidently forge ahead courageously.

A series of actions must be taken to realize the foregoing objectives. In discussing how to solve the environmental problems that China faces, Vice Minister Li Peng mentioned reliance first on policies, second on science, and third on control. These three measures are not only in keeping with present goals, but are also in keeping with the realization of goals for the year 2000.

As regards policies, it is necessary to make concrete basic policies such as the "three synchronouses" and "the one who pollutes is the one who cleans up," and to codify them in laws. Policies are guides for action. When policies are codified into laws, they can be carried out, and they have a binding force. We have a very strenuous building job to do in this regard.

As regards science, this requires the diffusion in large and medium-size enterprises and cities of the international techniques used during the late 1970's and the early 1980's as well as distinctively Chinese techniques for the prevention and control of environmental pollution. With the technical transformation of our industries and progress in science and technology, this requirement is attainable. This is the most substantial prerequisite for realization of environmental goals.

As regards control, this means the establishment from the national level to all local levels of a professional corps that is able to effect controls using laws, administrative methods, economic methods, propaganda, and education to promote the prevention and control of environmental pollution and finally to realize the year 2000 goals.

The backwardness of our present environmental control is manifested primarily in feeble supervision. Environmental protection units are supervisory units. Implementation of pertinent national environmental protection policies and regulations depends on environmental protection units. When supervision is strong, policies and regulations are carried out, thereby leading to effective protection and improvement of the environment. When supervision is not strong, policies and regulations become mere formalities. The environment cannot be effectively protected or may even deteriorate further. There are many reasons why environmental pollution has not been effectively controlled in China, but weak supervision is a major one of them.

Strengthening of environmental supervisory functions currently requires taking a firm grip on standards for the release of pollutants. One might say that standards for the release of environmental pollutants are a concentrated embodiment of environmental policies. If firm hold is taken on this link, numerous policies and laws may be made concrete and standardized. Therefore, standards may be said to be the principal basis for environmental supervision.

Formulation of standards for the release of pollutants has to proceed from realities as they exist in China, i.e., both public health and other ecological factors have to be taken into consideration, and national economic and technological abilities to provide support have to be considered too. Standards that are too high will surely not work, nor will standards that are too low. They have to be just right.

The formulation of standards regarding release of pollutants requires distinctions among different industries. Requirements will be different for industries of different sizes and in different locations. Standards for heavy industries and light industries should not be the same, nor should the requirements for large industrial plants, medium industrial plants, and small industrial plants be the same. Standards applied to industrial plants located in urban areas, residential areas, cultural and educational areas, convalescent areas, scenic and tourist areas, and in places where water sources are located should not be the same as for those in designated industrial zones, suburban areas, far out suburban areas, or the countryside. Application of a single standard everywhere is unscientific. No distinctions make for no policies.

Distinctions are also required regarding the times when standards apply. Two major categories of current standards and future standards may be put into effect. Current standards means those currently in effect. Future standards are those to be implemented several years or more than 10 years hence. What standards apply in the prevention and control of pollution for a plant that is carrying out technical transformation? Not the present standard since its requirements are too low. Future standards that are in keeping with requirements of the year 2000 goals have to be applied. It takes 3 to 5 or 7 to 8 years to build a large or medium-size industrial plant, so the "three synchronous" standards used may not be current ones. Here too future standards have to be applied. Otherwise, no sooner would a plant be built than it would no longer meet standards, and it would have to undergo technical transformation. Future standards have to be applied now to any given industrial plant. In 1986, standards for 1990 have to be applied, etc.

We are still a long way from meeting the foregoing requirements. Consequently, the study of standards and control work must be placed on an important agenda. Efforts should be made to perfect supervision work and standards work during the Seventh 5-Year Plan period so that environmental supervision will be strong and vigorous and so that environmental control will follow the track of legality and scientificalness.

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ENVIRONMENTAL QUALITY

BRIEFS

NATIONAL ENVIRONMENTAL BOARD ESTABLISHED--In keeping with development of the national economy and reform of the S&T system so that science and technology is oriented toward building the economy, and to develop a broad market for science and technology, following approval by the Chinese Academy of Sciences, the Chinese Academy of Sciences Environmental Impact Evaluation Board has been formally established. The Chinese Academy of Sciences Environmental Committee convened in Beijing during the past few days and forwarded the construction projects environmental impact evaluation certificate promulgated by the National Environmental Protection Bureau. This bureau is a new scientific research entity. The Chinese Academy of Sciences, with its numerous academic disciplines, its all-encompassing nature, and its advanced technical equipment, assembled technical personnel from environmental impact evaluation units in 20 institutes within the academy to form a strong corps made up primarily of high- and medium-rank research personnel in various specialties including environmental protection, engineering, hydrology, geology, meteorology, geochemistry, zoology and botany, biology, ecology, chemistry, physics, mathematics, computers, and the chemical industry. This board's orientation will be toward the whole country and it will be responsible for environmental impact assessment work pertaining to large and medium-size composite and individual construction projects, economic development areas, and area environmental plans. It will also further cooperate with construction project entrepreneurial units, local environmental protection units and other scientific research units to carry out environmental impact assessment work embracing multiple academic disciplines and multiple industries. [Text] [Beijing ZHONGGUO HUANJING BAO in Chinese 19 Feb 87 p 1] 9432

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